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GONST project WP 2 report

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1 Preface

This report is part of the Geography of Nordic Sustainability Transitions (GONST) project. In the project, researchers from Lund University; Aalborg University; Tampere University; the Nordic Institute for Studies in Innovation, Research and Education; SINTEF; and the Technical University of Denmark asked "Where does the green economy grow?" The project is funded by the Nordic Green Growth Research and Innovation Programme in cooperation with NordForsk, Nordic Innovation, and Nordic Energy Research (grant no. 83130).

2 Summary

Supporting the green transition and creating green growth poses challenges for regional innovation policy. Traditional accounts of green growth have relied on sectoral classifications. However, the empirical evidence indicates that the underlying assumption of this approach—i.e., that all firms within a predefined sector contribute to green growth and that all firms outside such sectors do not—is fundamentally wrong. This approach ignores the fact that green growth and sustainability transitions may occur in sectors that are not usually associated with eco-technologies (Shapira et al., 2014). This calls for a broader approach than the traditional ones used to identify sectors as being green. Therefore, a particular challenge for regional economies is how to promote conditions for firms introducing innovations that have environmental benefits for themselves, the users, or both—regardless of the sector.

Recent research has shown that the skills and human capital needed in green jobs are different from those of non-green jobs (Consoli et al., 2016). Based on detailed occupational data from the US, green jobs often require a higher level of human capital and specific cognitive and interpersonal skills. However, these green jobs are not directly translatable to the Nordic context. In addition, little is known on whether these green skills are actually important for firms that aim at developing eco-innovations. The identification of firms and skills related to eco-innovation allows for an analysis of their geographical distribution. Some regions have more firms involved in these innovations and have a larger share of people in the labor market with the needed skills, which could support green growth in these regions, while others lack these skills, which would hamper green growth.

The purpose of this report is to identify the regional distribution of green skills in the Nordic countries and analyze whether these are important for firms' introduction of eco-innovations. The report draws on a combination of firm-level survey data on eco-innovations linked with employer-employee census data from Denmark, Sweden, Finland, and Norway.

The report develops education-based and occupation-based indicators for green skills and compares them to other definitions. The result is five different definitions of green skills, of which two are based on an individual's occupation, two on their education, and one on firms' activities. Table 1 shows the distribution of green skills in the Nordic countries based on the five different definitions. The broad occupation-based measure of green skills (labeled *green*) accounts for the largest share of green skills in the four Nordic countries. This is a considerably lower number than found in Consoli et al. (2016), who argued that 9%–11% of all jobs in the US require green skills. However, these numbers are not directly comparable since Consoli

et al. (2016) used a US-specific type of data that is not available in the Nordic countries. Arguably, Consoli et al.'s (2016) percentage seems very high.

The narrower occupation-based measure (labeled *green GONST*) only found that between 0.25%–0.90% of occupations require green skills. This definition appears to be narrower and more precise in capturing green occupations, but it obviously only accounts for a limited number of people.

The education-based measures also only accounts for a low share of employees, ranging from 0.17% to 0.32%, except for Finland, where 2.41% of employees have a green education (more than 50,000 employees).

It seems to be obvious that the measures used here are not perfect in capturing all green skills. It may well be that the green economy is growing everywhere in all sorts of sectors and firms with employees with different types of education. The green economy is likely to consist of a mix of new objectives and new ways of doing things that could require a mix of specific green skills and more traditional skills. For example, an engineer with a construction education might apply their skills to serve new customer needs and switch from a firm that designed traditional power plants to a firm building solar panel power plants. However, special green skills may be needed if firms are going to become greener by introducing eco-innovations. The different Nordic countries show rather distinct patterns in their geographical distributions of these green skills, which may have implications for firms' capabilities to introduce eco-innovations.

Table 1: Green skills in the Nordic countries.

		Share with green skills				
		Occupation-based		Education-based		Activity-based
	Employment in 2014	**Green**	**Green GONST**	**Green**	**Green national**	**EGSS**
Denmark	2,619,627	3.65%	0.90%	0.32%	0.11%	0.36%
Norway	2,557,624	5.3 %	0.3 %	0.3 %	0.2 %	0.5%
Sweden	4,593,586	3.48%	0.78%	0.17%	-	0.49%
Finland	2,192,654	4.30%	0.25%	2.41%	-	0.28%

Table 2 summarizes the results of regression analyses on eco-innovation in the Nordic countries. The results show that the green skill indicators are positively related to firms' likelihood of introducing eco-innovations. The education-based definition of green skills is particularly positive and statistically significant for the likelihood of introducing eco-innovation across the four countries. The fact that this result was found for all four countries is a strong indication of the importance of green skills. These countries are quite similar, but

as shown by Tanner et al. (2019), there are also large differences in their technological profiles. Thus, green skills matter for firms' likelihood to introduce eco-innovations. However, it is not sufficient to hire someone with a green education in order to become eco-innovative. This will be explored further in upcoming discussions in the work package.

Table 2. Summary of regressions for eco-innovation.

	Denmark	Norway	Sweden	Finland
Green occupation	Not significant	Positive	Positive	Not significant
Green occupation GONST	Not significant	Positive	Positive	Not significant
Green education	Positive	Positive	Positive	Positive
Green education national	Positive	Positive	-	-
EGSS	Positive	Positive	Not significant	Not significant
Share of highly educated employees	Negative	Positive	Positive	Negative
Log(Size)	Positive	Positive	Positive	Positive
Region	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes

3 Methodology

In this report, several alternative methods for mapping the spatial distribution of green skills and eco-innovative firms were used. These two distributions were then compared using a regression analysis to study the co-occurrence of green skills and eco-innovation. Observing this co-occurrence will increase the validity of the measure of green skills and constitutes a basis for further work on the antecedents of eco-innovation. For this analysis, it is necessary to first delimit regions and industries.

Regions were initially defined at the NUTS 3 level (Nomenclature of Territorial Units for Statistics), while more details were added for some countries.

Industries were based on Eurostat's definition of industries according to the technological intensity of their manufacturing and services (see appendix for details).

3.1 Approaches to identifying green skills

In this report, three different approaches were used to identify green skills, which resulted in five different definitions and indicators of green skills. The first approach focuses on the activities of the firm at which a person works. If a person works at a firm that performs a green activity, then the person has green skills. The second approach defines an individual as having green skills if their education is classified as green. Finally, the third approach focuses on the tasks performed in the job of the individual. If their job's occupation code is classified as green, then the individual has green skills.

3.1.1 Activity-based green skills of EGSS industries

The activity-based definition of green skills is based on Eurostat's definition of the environmental goods and services (EGSS) industry (Eurostat 2016). The green industries are defined as a narrow selection of industries that are closely related to recycling and environmental protection. Obviously, this is a very simple definition that only covers a small share of employees and firms potentially involved in eco-innovation. See the detailed definition of activity-based green skills in the appendix.

3.1.2 Green educations

Two education-based approaches were used to identify green skills. One definition is based on International Standard Classification of Education (ISCED), while the other is based on national educational codes. For both definitions, we only considered education at a level corresponding to a vocational bachelor (level 5 in the European Qualification Framework) or higher.

The *green* indicator is based on four ISCED 2013F fields of education: 0521 (environmental sciences), 0522 (natural environments and wildlife), 0712 (environmental protection technology), and 0713 (electricity and energy). See the definition in the appendix. The national definitions are elaborated in the country-specific sections.

3.1.3 Green occupations

The occupation-based approach resulted in two definitions. The first definition of green is based on a translation of the definition of green skills in Vona et al. (2015). They investigated which vocations that

corresponded with green tasks using O*NET, a US occupational information network. We will make use of occupations with a "greenness" above 1 in Vona et al.'s 2015 work (p. 43). The approach is also similar to that used by Yi (2013).

These green occupations were translated from the American Standard Occupational Classification (SOC) from 2010 into the International Labour Organization's (ILO) International Standard Classification of Occupations (ISCO).[1] The ISCO code is not as nuanced as the 2010 SOC. However, in Norway, Denmark, and other countries, more detailed occupational codes exist that enabled us to come closer to the definition in Vona et al. (2015). The results of a direct application of the crosswalk between SOC and ISCO are presented in the appendix. This approach can lead to categories that appear rather broad.

The second definition labelled *green GONST* is based on a text-based analysis of the ISCO-08 detailed descriptions of tasks related to occupations using the following search strings: "environ," "energy," "waste," "recycle," "wind," and "solar."[2] This definition appears to be narrower and more precise in capturing green occupations. See the detailed definitions in the appendix.

3.2 Identification of eco-innovators

When identifying environmentally innovative firms, we included innovations that have environmental benefits for users (e.g., windmills), the firm itself (e.g., reduced CO2 emissions), or both. In addition, an input-based indicator based on firms' research and development (R&D) activities was used. As such, the identification of eco-innovative firms was based on innovation survey data and R&D spending data.

For Denmark, Sweden, and Finland, the innovation output–based approach was taken from the Community Innovation Survey (CIS) 2014. This survey included a voluntary module on innovations with benefits for the environment. In the survey, firms indicate whether they had introduced innovations with one or more environmental benefit in the period from 2012–2014. The benefits could be for the firm itself or produced during the use of the product or service by the end-user. See the detailed descriptions in the appendix.

This module was not included in the Norwegian CIS. However, the Norwegian Survey on Research and Development and Innovation asked Norwegian firms to what degree was the reduction of environmental impacts important when developing new products (see Section 5 for more details). We were therefore able to identify eco-innovators in all countries included in the report.

3.3 Methodological differences in the analyses

Green skills and eco-innovators in Denmark, Norway, Sweden, and Finland are discussed in Sections 4, 5, 6, and 7, respectively. Each of these sections include country-specific methodological considerations. This includes descriptions of the country-specific data sources, country-specific differences in the spatial level of the analysis, and country-specific differences in the operationalization of green skills and of eco-innovators.

[1] Crosswalk developed by the Bureau of Labor Statistics: https://www.bls.gov/soc/soccrosswalks.htm
[2] The ILO's international standard classification of occupations: http://www.ilo.org/public/english/bureau/stat/isco/ and http://www.ilo.org/public/english/bureau/stat/isco/docs/groupdefn08.pdf

4 Country report: Denmark

4.1 Introduction

This section analyzes the geographic distribution of skills and environmentally innovative firms in Denmark.

4.2 Methodology

The analysis drew on the Danish matched employer-employee database and the Danish Research and Innovation Survey. The Integrated Database for Labor Market Research (IDA database) contains detailed information on all firms, plants, and individuals from 1980 onwards that are active in the Danish labor market. The database contains detailed information on people's educations and occupations. The Danish Research and Innovation Survey is a yearly, mandatory survey that contains information on the research and innovation activities of a stratified sample of approximately 4,500 firms out of a population of 22,000 firms in Denmark. The firms are selected based on size, industry affiliation, and R&D intensity. The surveys follow the same structure and definitions as the CIS.

Denmark consists of five NUTS 2 regions that corresponds to the five administrative regions and 11 NUTS 3 regions. In order to capture differences in the regional labor markets and industrial structures, the analysis was conducted at the NUTS 3 level. The 99 Danish municipalities were used for some of the analyses. An alternative approach would have been to use functional urban regions, but that would have limited the usability of the data when comparing it to other work packages in the GONST project and the data's comparability with Norway, Finland, and Sweden.

4.2.1 Approaches to identifying green skills in Denmark

In addition to the definition of green activities, green educations, and green occupations as explained in Section 3, an additional educational definition was used in the analysis of Danish data. The *green Denmark* indicator was based on a textual analysis of the Danish DISCED-15 codes and related AUDD codes. The search words were "*miljø"* (environment), "*genbrug"* (recycle), "*affald"* (waste), "*energy"* (energy), "*vind"* (wind), "*bæredygtig"* (sustainability), "*natur"* (nature), and "*økologi"* (organic). See the detailed definition in the appendix.

4.2.2 Identification of eco-innovators in Denmark

When identifying environmental innovative firms, we included innovations that have environmental benefits for users (e.g., windmills), the firm itself (e.g., reduced CO2 emissions), or both. The identification of eco-innovative firms was based on two approaches. The first was an output-based approach taken from the Danish version of the CIS 2014 survey. This survey included a voluntary module on innovations with benefits for the environment. In the Danish survey, they ask if the firm introduced changes or innovations with one or more environmental benefits in the period from 2012–2014. The benefits could be for the firm itself or produced during the use of the product or service by the end-user. See the detailed definition of eco-innovative firms in the appendix.

The second approach was input-based. This used information on firms' R&D spending from the Danish CIS survey. Unfortunately, these questions are only asked every second year (uneven years). Therefore, it was

not possible to obtain data on eco-innovations and green R&D activities for the same year, and the CIS survey for 2013 was consequently used for the R&D data. The CIS data contains information on the specific research fields for R&D expenditures. The fields that appear to be the most relevant are environmental and energy research. However, these fields are closely related to other fields. That is, research spending in fields closely related to environmental and energy research could be considered as green if firms that have R&D in these fields are also conducting research in other seemingly unrelated areas.[3] Therefore, a cluster analysis was conducted on firms' R&D spending in different fields to identify systematic co-occurrences in green R&D spending. The analysis revealed that spending on the environment and energy at the firm level was closely related to spending on materials, construction, and nanotechnology. Therefore, firms that have R&D spending in these fields were also considered to be targeting eco-innovations. See the appendix for details.

4.3 Results

Table 3 shows the share and number of employees with green skills in Denmark according to the five different definitions for the year 2014. The broad occupation-based definition (labeled *green* in the table) is the largest category with more than 95,500 employees, amounting to 3.65% of the total number of employees in Denmark. The more precise and narrower *green GONST* sums to 23,500, which is only 0.87 % of the total workforce. The education-based definitions resulted in fewer employees with green skills. The broad education-based definition *green* resulted in 8,382 jobs, while the narrower definition based on the Danish educational codes *green Denmark* only identified 2,881 jobs, or 0.11% of the total employment. The activity-based EGSS definition resulted in 9,430 jobs, which is equivalent to 0.36% of the total number of employees.

Table 3. Share and number of employees with green skills in Denmark in 2014.

		Share with green skills				
		Occupation-based		Education-based		Activity -based
	Employment in 2014	**Green**	**Green GONST**	**Green**	**Green Denmark**	**EGSS**
DK011 Copenhagen City	405,298	2.95%	1.34%	0.29%	0.20%	0.15%
DK012 Copenhagen Surroundings	307,492	4.13%	1.65%	0.66%	0.16%	0.45%
DK013 North Zealand	166,236	3.61%	1.00%	0.50%	0.12%	0.22%
DK014 Bornholm	16,242	2.79%	0.43%	0.07%	0.05%	0.60%
DK021 East Zealand	93,008	3.03%	0.75%	0.20%	0.15%	0.45%
DK022 West and South Zealand	214,303	2.67%	0.51%	0.12%	0.07%	0.41%
DK031 Funen	200,974	3.67%	0.48%	0.13%	0.04%	0.59%
DK032 South Jutland	330,660	4.57%	0.77%	0.28%	0.06%	0.37%
DK041 West Jutland	204,209	4.70%	0.47%	0.32%	0.06%	0.38%
DK042 East Jutland	387,278	3.69%	0.86%	0.40%	0.06%	0.36%

[3] The analysis is inspired by Hidalgo et al. (2007).

DK050 North Jutland	258,063	3.72%	0.59%	0.21%	0.12%	0.48%
Not regionalized	35,864	0.17%	0.03%	0.06%	0.06%	0.00%
Total	2,619,627	3.65%	0.90%	0.32%	0.11%	0.36%

Note: *Employment* refers to the number of employment relations in November 2014 where only the main job for each person was counted and when the data on education and occupation was available.

Table 4 shows the distribution of firms in Denmark with at least one employee with green skills according to the five different definitions. It can be seen that the employees with green skills are fairly broadly distributed across firms. One exception is the activity-based definition, where employees are concentrated in a few hundred firms. More surprisingly, there is also some concentration in the occupation-based measure *green GONST*, where the share of employees with green skills and share of firms employing these is almost identical (0.90% and 0.89% respectively).

Table 4. Share and number of firms with employees with green skills in Denmark in 2014.

		Share with green skills				
		Occupation-based		Education-based		Activity-based
Region	**Firms in 2014**	**Green**	**Green GONST**	**Green**	**Green Denmark**	**EGSS**
DK011 Copenhagen City	37,549	5.60%	0.74%	0.77%	0.52%	0.06%
DK012 Copenhagen Surroundings	22,622	9.06%	0.92%	1.77%	0.42%	0.13%
DK013 North Zealand	23,711	6.17%	0.68%	1.37%	0.30%	0.09%
DK014 Bornholm	2,120	6.79%	0.55%	0.38%	0.14%	0.14%
DK021 East Zealand	12,056	10.85%	2.01%	2.03%	1.29%	0.22%
DK022 West and South Zealand	27,874	5.80%	0.63%	0.47%	0.24%	0.23%
DK031 Funen	21,529	7.26%	0.61%	0.54%	0.19%	0.19%
DK032 South Jutland	33,228	8.88%	0.88%	0.84%	0.23%	0.16%
DK041 West Jutland	22,008	8.97%	0.67%	0.72%	0.25%	0.18%
DK042 East Jutland	40,367	9.67%	1.39%	1.70%	0.55%	0.15%
DK050 North Jutland	27,621	7.80%	0.72%	0.63%	0.43%	0.21%
Not regionalized	460	0.00%	0.00%	0.65%	0.87%	0.00%
Total	271,145	7.82%	0.89%	1.04%	0.41%	0.15%

The five different definitions of green skills show a rather distinct geographical pattern of green skills in Denmark (see Table 5). A location quotient (LQ) higher than one indicates that the region is specialized—that is, the region's share of employees with green skills is higher than the region's share of the total number of employees in Denmark. The activity-based EGSS definition shows a high specialization in Bornholm, Funen, and North Jutland; however, there distribution of EGSS firms shows no clear overlap with the other definitions. The education-based measure *green* shows strong specialization in Copenhagen Surroundings, North Zealand, and East Jutland, which are also the regions with the highest share of highly educated

employees. Copenhagen Surroundings, Copenhagen City, East Zealand, North Zealand, and North Jutland are specialized in green skills according to the narrow education-based definition *green GONST*. Copenhagen City, Copenhagen Surroundings, and North Zealand are specialized in green skills according to the occupation-based measure *green GONST*.

Table 5. Regional specialization patterns in Denmark.

		Location quotient in 2014				
		Occupation-based		Education-based		Activity-based
Region	**Employment in 2014**	**Green**	**Green GONST**	**Green**	**Green Denmark**	**EGSS**
DK011 Copenhagen City	405,298	0.80	1.48	0.90	1.88	0.40
DK012 Copenhagen Surroundings	307,492	1.12	1.82	2.03	1.49	1.22
DK013 North Zealand	166,236	0.98	1.11	1.54	1.15	0.60
DK014 Bornholm	16,242	0.75	0.47	0.23	0.47	1.64
DK021 East Zealand	93,008	0.82	0.83	0.61	1.41	1.21
DK022 West and South Zealand	214,303	0.72	0.57	0.36	0.70	1.12
DK031 Funen	200,974	0.99	0.53	0.38	0.36	1.61
DK032 South Jutland	330,660	1.24	0.85	0.86	0.57	1.00
DK041 West Jutland	204,209	1.27	0.51	0.99	0.58	1.02
DK042 East Jutland	387,278	1.00	0.95	1.22	0.55	0.98
DK050 North Jutland	258,063	1.01	0.65	0.65	1.15	1.31
Not regionalized	35,864	0.05	0.04	0.17	0.53	0.00
Total	2,619,627	1.00	1.00	1.00	1.00	1.00

Figures 1 and 3 show the regional specialization patterns at the NUTS 3 level for the education- and occupation-based definitions, which is comparable to the definitions applied in the other Nordic countries. These repeat the patterns shown in Table 5 with no clear specialization in terms of green occupations and some specialization around the capital area in terms of green educations. A comparison of Figures 1 to 5 reveal that the geographical specialization pattern in Denmark depends on the applied definition. This suggest that there is little overlap between the different definitions. This is analyzed in the next section.

*Figure 1. Location quotient (LQ) of green jobs (*green*) by NUTS 3 regions in 2014.*

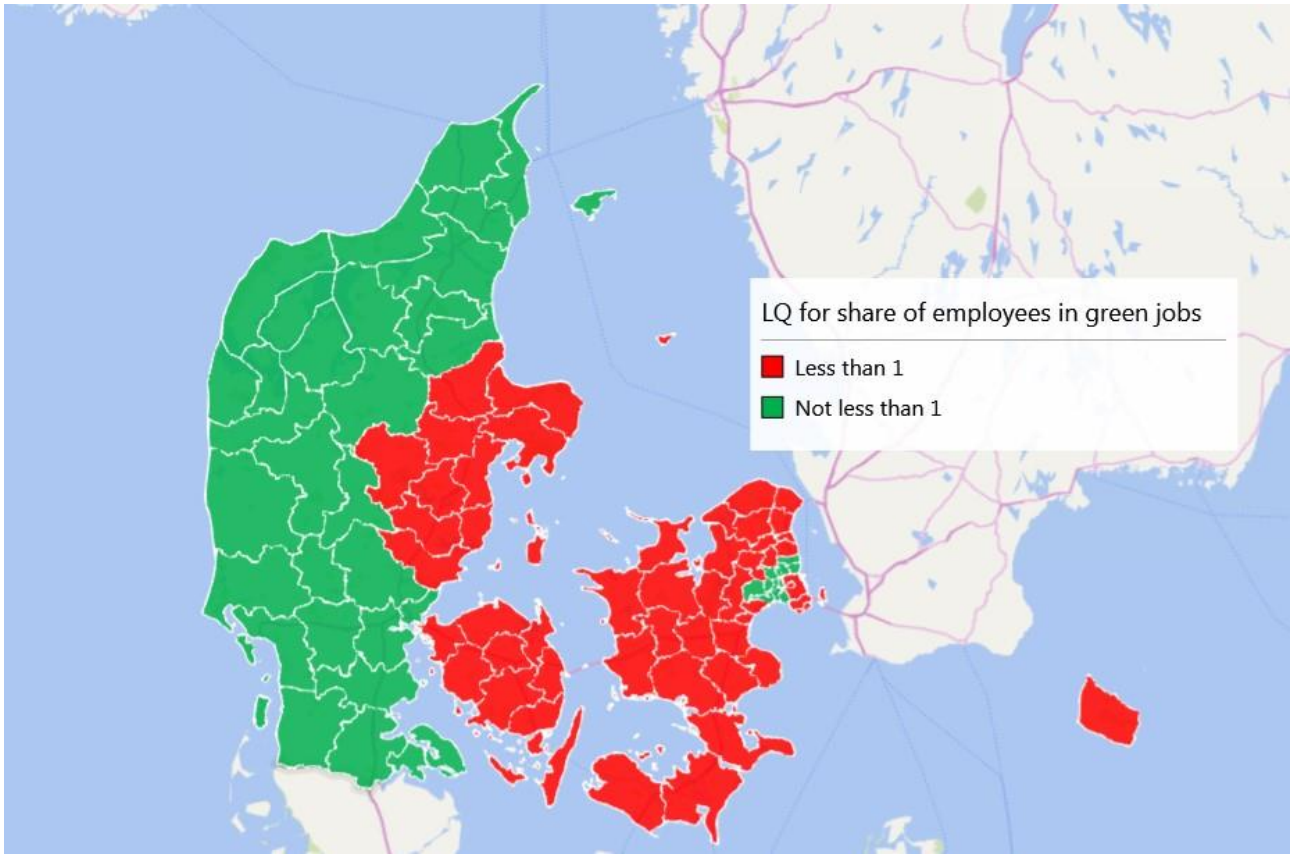


*Figure 2. LQ of green jobs (*green GONST*) by NUTS 3 regions in 2014.*

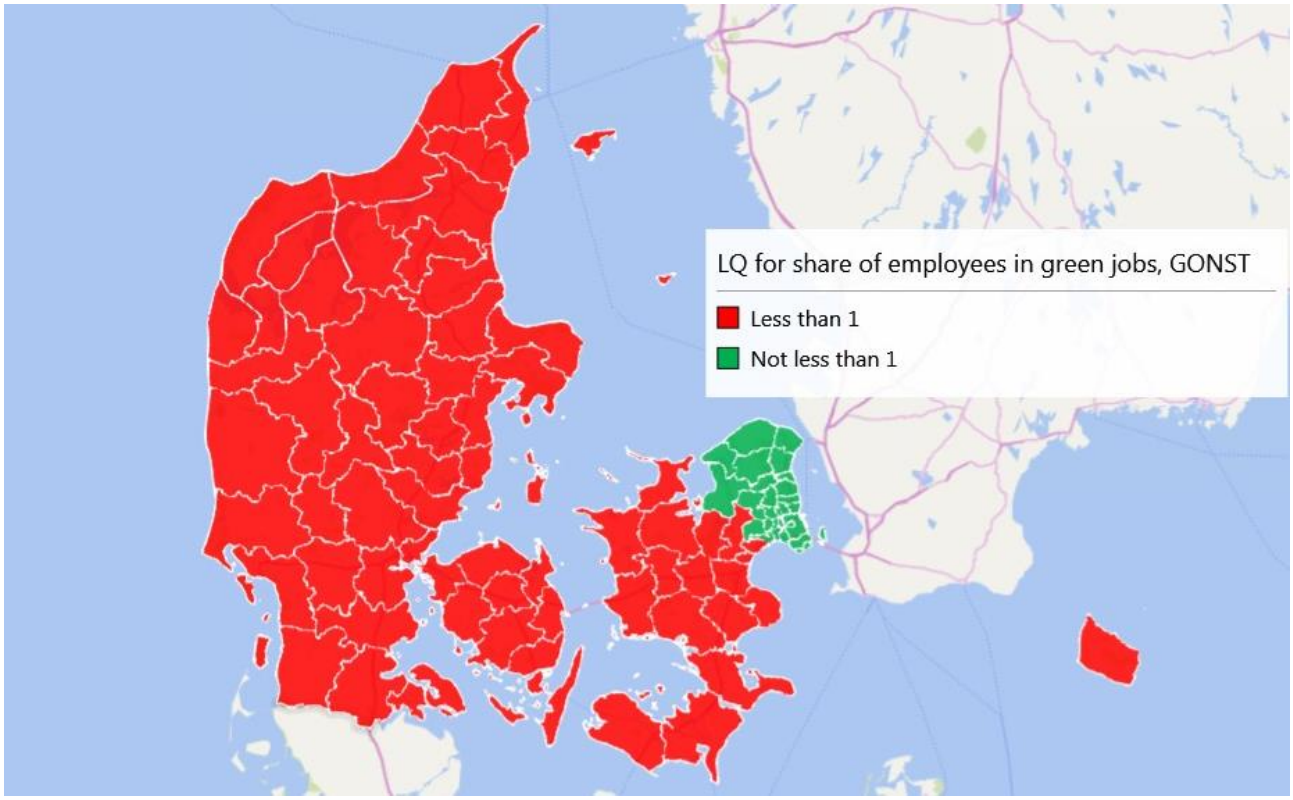


*Figure 3. LQ of green educations (*green*) by NUTS 3 regions in 2014.*

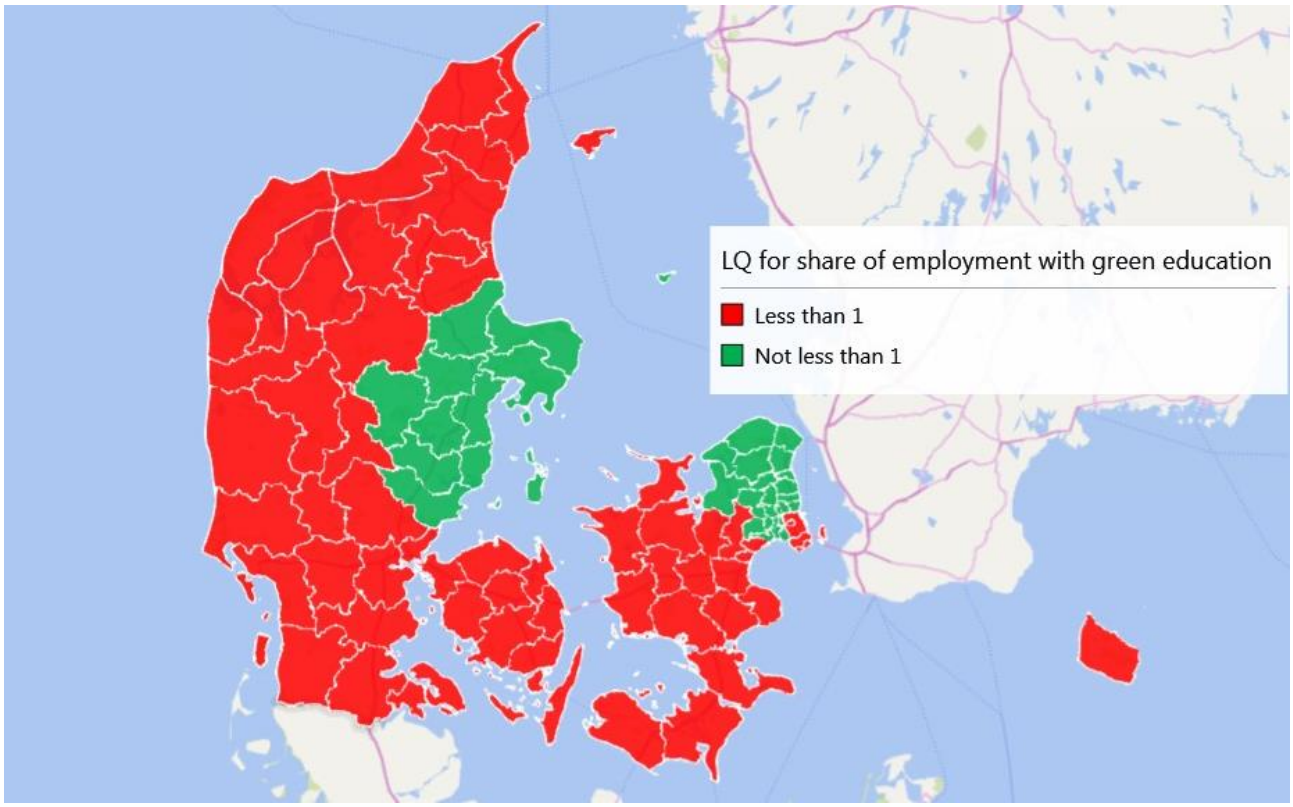


*Figure 4. LQ of green educations (*green Denmark*) by NUTS 3 regions.*

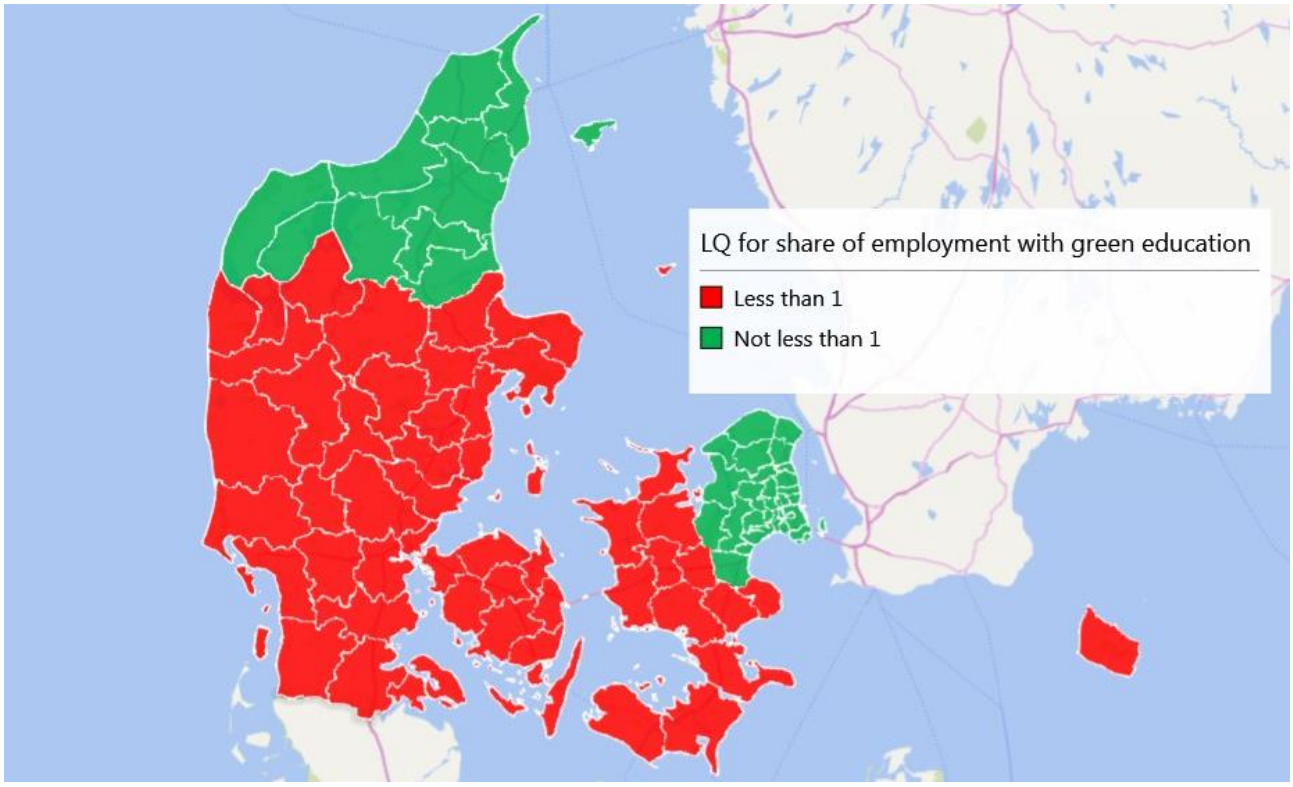
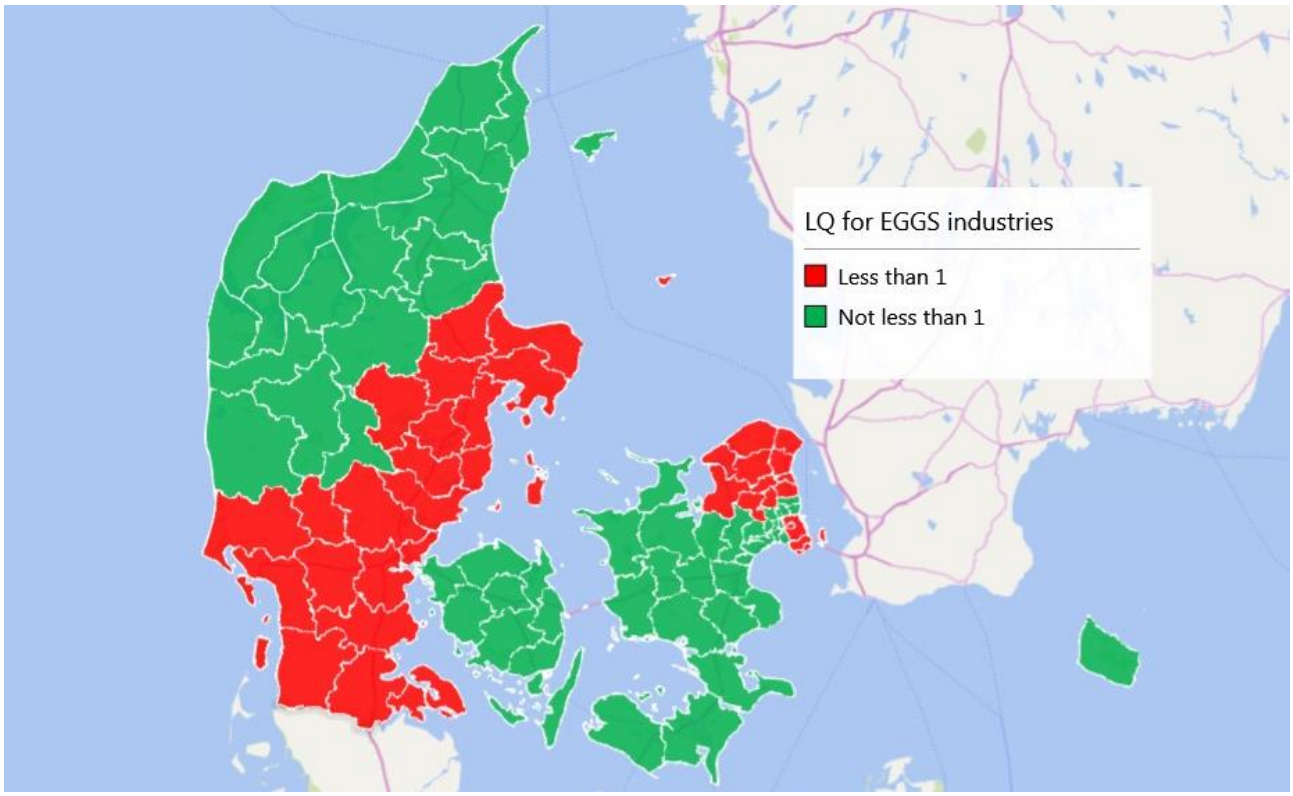


*Figure 5. LQ of employees in green activities (*EGSS*) by NUTS 3 regions in 2014.*



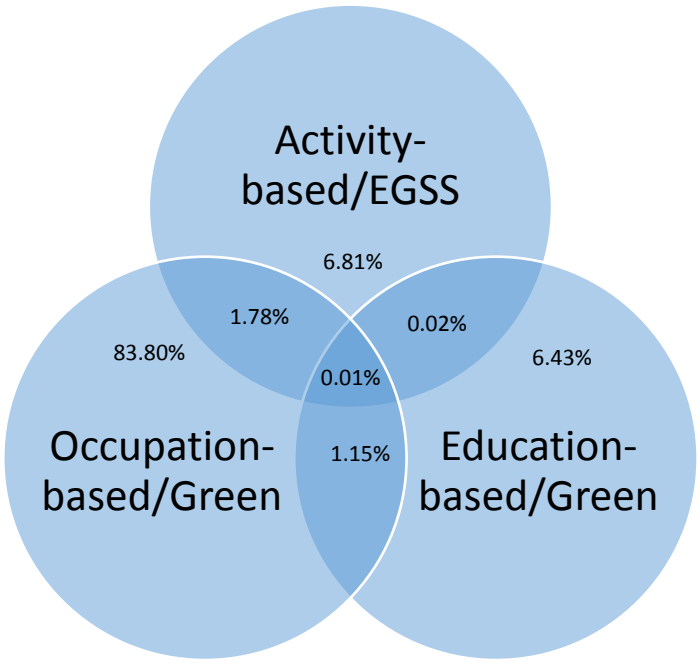
4.3.1 Overlap between the different definitions of green skills

Table 3 shows that out of 2,619,627 employees in 2014, 3.65% had a green occupation, 0.32% had a green education, and 0.36 % had a job in a green activity. This implies that 4.33% or 113,430 employees are green one way or the other, but the number is of course smaller as some of these overlap. For example, some people with jobs in green activities also have green educations.

The Venn diagram in Figure 6 shows that the overlap is in fact relatively limited. There are 111,323 employees, with green skills in at least one way, and of these, 108,031 have green skills in only one of the three dimensions (occupation, education, or activity). Only 10 people, or 0.01%, have green skills along all three dimensions.

The lack of overlap demonstrates the diversity and ubiquity of green activities. Most people with green job descriptions do not have a green education and do not work at firms classified as involved in green activities. Similarly, most people with a green education do not work in a green job or at a green firm, and most people in green firms have neither a green education nor a green job.

Figure 6. The overlap of the three definitions in 2014.



4.3.2 Eco-innovators

In 2014, 4,900 firms participated in the overall research and innovation survey, but only 1,927 firms participated in the voluntary part on environmental innovation. It is likely that firms not engaged in successful innovation activities and firms not active in innovations with environmental benefits did not answer this part of the survey. Weights were applied to make the sample representative for the entire Danish population of

firms in terms of size and industry distribution. When weighted, the 1,927 firms represent 6,322 firms in the economy. The R&D question in 2013 was mandatory, so all 4,784 firms on CIS 2013 replied. These should represent 18,674 firms in the economy. Due to the stratification of the sample towards large and R&D-active firms, the weights were higher for small firms and close to one for firms with more than 100 employees. The share of environmentally innovative firms was 34.6% (unweighted, 41.7%) while the share of innovative firms in the overall sample was 44%. For green R&D, there were 18,500 observations (unweighted, 4,767) of which 2.3% had green R&D spending (unweighted, 4.2%). The share of firms that had R&D spending was 12.8% (weighted).

The distribution of green innovators and green R&D can be seen in Table 6. The table shows some overlap between green innovations and green R&D, such as for North Zealand, Funen, and West Jutland, which were all are specialized according to both measures (see also Figure 7). However, the share of firms with green innovations is much larger than the share with green R&D. More than 32% of the firms had a green innovation in 2014, while only 2.2% had R&D spending.

Table 6. Green innovators in Denmark in 2014.

		Share with green innovations and R&D			
		Green innovation		Green R&D (2013)	
Region	**Firms in 2014**	**In region**	**LQ**	**In region**	**LQ**
DK011 Copenhagen City	1,039	0.184	0.57	0.016	0.73
DK012 Copenhagen Surroundings	626	0.290	0.90	0.026	1.18
DK013 North Zealand	403	0.366	1.13	0.047	2.14
DK014 Bornholm	Discretion	0.000	0.00	0.018	0.82
DK021 East Zealand	399	0.303	0.94	0.012	0.55
DK022 West and South Zealand	347	0.411	1.27	0.017	0.77
DK031 Funen	391	0.379	1.17	0.033	1.50
DK032 South Jutland	615	0.446	1.38	0.021	0.95
DK041 West Jutland	384	0.424	1.31	0.035	1.59
DK042 East Jutland	1,108	0.359	1.11	0.021	0.95
DK050 North Jutland	415	0.312	0.96	0.012	0.55
Not regionalized	594	0.262	0.81	0.008	0.36
Total	6,322	0.324	1.00	0.022	1.00

Note: Number for regions with less than ten firms in the sample are not shown.

Figure 7. LQ of eco-innovators by NUTS3 regions in 2014.

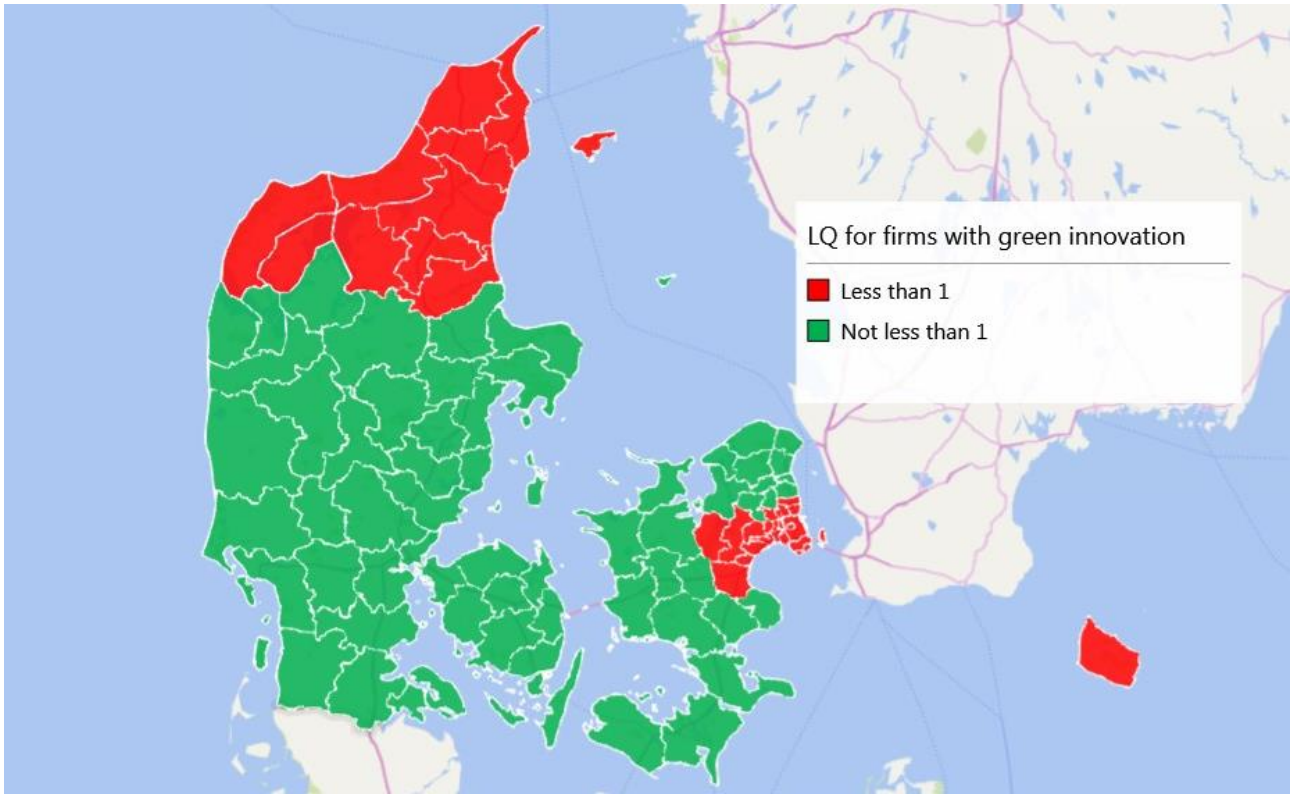
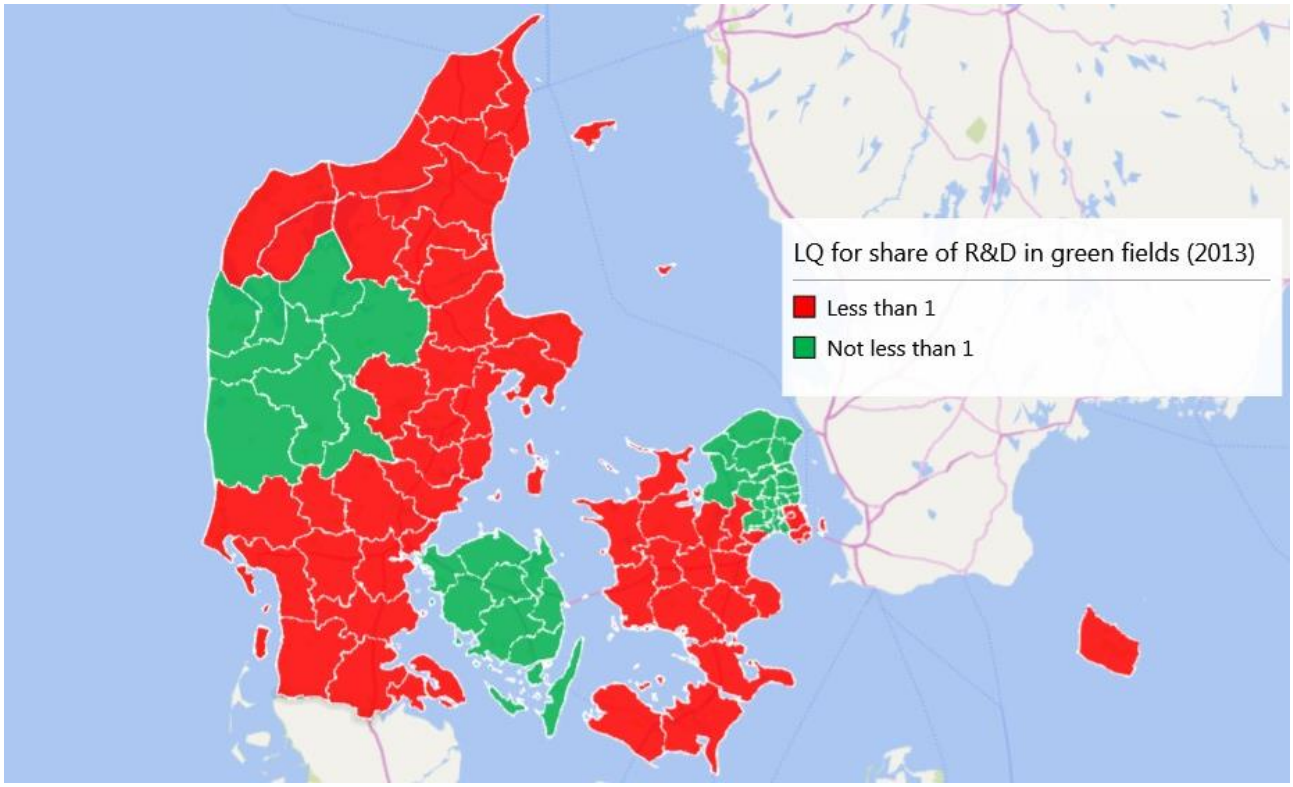


Figure 8. LQ of green R&D by NUTS 3 regions in 2014.



The relatively few employees with green skills caused a concern that the various definitions might have captured too few green skills relevant to environmental innovation. Therefore, the share of these green-skilled employees were used in logistic regressions for the likelihood of a firm introducing an innovation with environmental benefits. The analysis controlled for the share of employees with a higher education, region, industry, and size.

4.3.3 Eco-innovations and green skills

Table 7 shows the regression results for the likelihood of introducing innovations with environmental benefits for seven different models. The *green occupation* indicator was only positive and statistically significant in model 1, while the narrower definition *green occupation GONST* never was significant. The indicators based on education, *green education* and *green education Denmark,* as well as the activity-based *EGSS* were positive and significant in all models. The overall results of the regression analyses indicate that despite the low number of green-skilled employees, it seems to be positively related to eco-innovations.

The analyses also showed some distinct regional differences. The North Zealand and South Jutland regions were statistically significant and positively related to eco-innovations compared to the North Jutland region. Size was positively related to eco-innovation. Most manufacturing industries were also positively related to introducing eco-innovations, while the service industries were significantly less likely to introduce eco-innovations.

Table 7. Summary of regression results for eco-innovation.

Parameter	Estimate		Estimate		Estimate		Estimate		Estimate		Estimate		Estimate	
	Model (1)		Model (2)		Model (3)		Model (4)		Model (5)		Model (6)		Model (7)	
Intercept	-1.403	***	-1.383	***	-1.402	***	-1.400	***	-1.411	***	-1.447	***	-1.427	***
Green occupation	0.237										0.208			
Green occupation GONST			0.239										0.098	
Green education					3.617	***					3.639	***		
Green education Denmark							19.978	***					19.846	***
EGSS									1.108	**	1.123	**	1.120	**
Share of highly educated employees	-0.389	***	-0.380	***	-0.493	***	-0.397	***	-0.371	***	-0.497	***	-0.391	***
Log(Size)	0.237	***	0.235	***	0.239	***	0.235	***	0.237	***	0.240	***	0.236	***
DK011 Copenhagen City	-0.134		-0.140		-0.113		-0.158		-0.135		-0.104		-0.154	
DK012 Copenhagen Surroundings	0.118		0.118		0.106		0.142		0.120		0.112		0.146	
DK013 North Zealand	0.407	*	0.400	*	0.412	*	0.424	*	0.407	*	0.423	*	0.427	*
DK014 Bornholm	-1.351		-1.347		-1.348		-1.359		-1.350		-1.351		-1.349	
DK021 East Zealand	-0.189		-0.192		-0.199		-0.177		-0.194		-0.194		-0.177	
DK022 West and South Zealand	0.189		0.191		0.197		0.206		0.197		0.203		0.212	

DK031 Funen	0.197		0.194		0.201		0.215		0.186		0.196		0.206	
DK032 South Jutland	0.449	**	0.452	**	0.447	**	0.470	**	0.452	**	0.440	**	0.466	**
DK042 East Jutland	0.181		0.183		0.174		0.190		0.184		0.175		0.192	
DK041 West Jutland	0.276		0.280		0.287		0.289		0.287		0.284		0.290	
Other services	-0.151	**	-0.151	**	-0.144	**	-0.161	**	-0.130	*	-0.118	*	-0.136	**
High-tech manufacturing	0.217		0.219		0.088		0.191		0.243		0.105		0.212	
Medium high-tech manufacturing	0.815	***	0.828	***	0.836	***	0.839	***	0.850	***	0.853	***	0.866	***
Medium low-tech manufacturing	0.380	***	0.389	***	0.403	***	0.396	***	0.410	***	0.425	***	0.423	***
Low-tech manufacturing	0.711	***	0.712	***	0.727	***	0.729	***	0.734	***	0.755	***	0.757	***
High-tech, knowledge-intensive services	-0.507	***	-0.521	***	-0.559	***	-0.508	***	-0.495	***	-0.529	***	-0.488	***
Knowledge-intensive market services	-0.251	***	-0.257	***	-0.227	***	-0.297	***	-0.232	***	-0.202	**	-0.277	***
Knowledge-intensive financial services	-1.226	***	-1.229	***	-1.199	***	-1.215	***	-1.214	***	-1.170	***	-1.192	***
Other knowledge-intensive services	-0.660	***	-0.682	***	-0.617	***	-0.653	***	-0.651	***	-0.585	***	-0.635	***
R^2	0.3171		0.3168		0.3251		0.3399		0.3196		0.3283		0.3427	
Number of observations	1,739		1,739		1,739		1,739		1,739		1,739		1,739	

4.3.4 Results of using the green R&D indicator

Table 8 shows the regression results when using green R&D as an indicator for eco-innovation. The *green occupation* indicator was statistically significant and positively related to green R&D, while the more narrowly defined *green occupation GONST* was only statistically significant in model 9. The education-based indicator *green education* was not significant, while the narrower *green education Denmark* was positively and statistically significant related to green R&D. The activity-based *EGSS* indicator was also positively and significantly related to green R&D.

There was more regional variation in green R&D compared to the result for eco-innovations. North Zealand, Funen, and West Jutland were positively and significantly related to green R&D spending compared to the North Jutland region, while Copenhagen City, East Zealand, and East Jutland were negatively related compared to North Jutland.

Table 8. Summary of regression results for green R&D.

Parameter	Estimate		Estimate		Estimate		Estimate		Estimate		Estimate		Estimate	
	Model (8)		Model (9)		Model (10)		Model (11)		Model (12)		Model (13)		Model (14)	
Intercept	-6.939	***	-6.814	***	-6.830	***	-6.835	***	-6.880	***	-6.981	***	-6.865	***
Green occupation	1.023	***									1.010	***		
Green occupation GONST			0.496	***									0.384	
Green education					0.363						0.044			
Green education Denmark							6.320	***					6.298	***
EGSS									1.446	***	1.403	***	1.409	***
Share of highly educated employees	3.773	***	3.754	***	3.764	***	3.686	***	3.803	***	3.806	***	3.704	***
Log(Size)	0.408	***	0.399	***	0.404	***	0.411	***	0.406	***	0.408	***	0.407	***
DK011 Copenhagen City	-0.693	***	-0.716	***	-0.719	***	-0.712	***	-0.715	***	-0.689	***	-0.702	***
DK012 Copenhagen Surroundings	0.163		0.176		0.176		0.196		0.182		0.166		0.199	
DK013 North Zealand	0.670	***	0.675	***	0.674	***	0.676	***	0.680	***	0.675	***	0.681	***
DK014 Bornholm	0.518		0.542		0.536		0.537		0.499		0.495		0.509	
DK021 East Zealand	-0.752	***	-0.758	***	-0.753	***	-0.780	***	-0.749	***	-0.750	***	-0.781	***
DK022 West and South Zealand	-0.047		-0.066		-0.062		-0.054		-0.061		-0.045		-0.056	
DK031 Funen	0.393	**	0.446	**	0.443	**	0.464	***	0.445	**	0.396	**	0.469	***
DK032 South Jutland	0.044		0.042		0.041		0.052		0.054		0.057		0.065	
DK042 East Jutland	-0.410	***	-0.424	***	-0.424	***	-0.464	***	-0.415	***	-0.404	***	-0.457	***
DK041 West Jutland	0.738	***	0.723	***	0.729	***	0.743	***	0.741	***	0.748	***	0.749	***
Other services	0.213		0.200		0.197		0.182		0.224		0.240		0.211	
High-tech manufacturing	0.084		0.092		0.072		0.085		0.105		0.106		0.113	
Medium high-tech manufacturing	2.628	***	2.685	***	2.682	***	2.677	***	2.714	***	2.659	***	2.710	***
Medium low-tech manufacturing	0.671	**	0.707	**	0.706	**	0.687	**	0.738	**	0.704	**	0.722	**
Low-tech manufacturing	0.231		0.229		0.227		0.212		0.258		0.263		0.246	
High-tech, knowledge-intensive services	0.516	**	0.464	*	0.466	*	0.488	**	0.485	**	0.534	**	0.502	**
Knowledge-intensive market services	0.053		0.043		0.064		0.040		0.074		0.065		0.038	
Knowledge-intensive financial services	-2.987	**	-3.000	**	-3.006	**	-2.984	**	-2.991	**	-2.969	**	-2.957	**
Other knowledge-intensive services	-2.831	**	-2.891	**	-2.892	**	-2.858	**	-2.879	**	-2.817	**	-2.838	**
R^2	0.1462		0.1445		0.1443		0.1480		0.1454		0.1475		0.1495	
Number of observations	4,634		4,634		4,634		4,634		4,634		4,634		4,634	

5 Country report: Norway

5.1 Introduction

This section lays out the approach used for Norway and presents analyses utilizing this approach. Norway differs from its neighbors in a number of important respects. A major distinction is the degree to which the "brown economy" (petroleum exploration and extraction) features in the Norwegian economy: It accounts for over a quarter of GDP (26% in 2000) and roughly half of the goods the country exports. Another characteristic of Norway that is important in this context is the high degree to which renewables already feature in its energy mix: Hydroelectric energy accounts for over 95% of its electricity generation.

5.2 Methodology

In order to understand the skills that underlie eco-innovations in Norway, we followed the three-pronged approach laid out above. The first prong was based on occupation characteristics of employees, the second on the educational profile of employees, while the third addresses firm-level activities potentially associated with eco-innovation. This section reviews the implementation of this approach, highlighting a few idiosyncrasies in the Norwegian context.

First, we note that this presentation is based on a single year (2013) of data and that it was assessed based on datasets provided by Statistics Norway.[4] In this context, we implemented the following:

- Regionalization of data: The localization of firms was conducted at the NUTS 3 level, corresponding to the Norwegian *fylke* (county). There were 19 counties in Norway in 2013.
- Industrial classification: We implemented Eurostat's EGSS definition. This NACE-based classification system was used to categorize firms (i.e., the employers) as green or not (ICEDD for Eurostat, 2009, p. 91). There were 410 EGSS enterprises in Norway in 2013 with a total of 7,700 employees.
- Eco-innovation: We utilized CIS 2013 from Statistics Norway. Norway did not implement the EU-harmonized proposal on environmental innovators. Instead, it offered two ways to take stock of eco-innovations: The first was based on the reported environmental effects of innovation, and the second was based on R&D expenditures earmarked to (i) renewable energy and (ii) CO2 mitigation technologies. All Norwegian firms were obligated to respond to CIS 2013.

We will explore these in more detail in terms of (i) how we identified green skills (Section 4.2.1) and (ii) how we identified eco-innovators (Section 4.2.2.). More generally, it is worth noting that although the Nordic countries all implement the same nomenclatures to categorize occupations (ISCO), industries (NACE), and educations (ISCED), these implementations may differ slightly across countries.

5.2.1 Approaches to identifying green skills in Norway

We explored three avenues for identifying green skills. The first two focused on vocations and are based on Vona et al. (2015). This approach utilizes a correspondence between individual vocations and a set of green

[4] The data source was explored in the frame of *Innovasjon i næringslivet-kunnskapsgrunnlag og indikatorer* (*avtale* 11/172)

tasks. In particular, it follows the thresholds used by Yi (2013) to associate a number of occupations with different levels of "greenness " (see Vona et al., 2015, p. 43).[5]

The resulting set of green vocations were revealed to be overly broad. We therefore departed from the classification in isolated cases.[6] We ended up employing a refined definition that excludes the most general categories of occupations from Vona et al. (2015).[7] This yielded the following list:

- 2133: Environmental protection professionals
- 3131: Power production plant operators
- 3132: Incinerator and water treatment plant operators
- 9611: Garbage and recycling collectors
- 9612: Refuse sorters

In general, the Norwegian occupation codes (STYRK) are more nuanced than the ISCO codes. A third avenue was therefore explored for the Norwegian case that may have led to a more fine-tuned definition of green occupations. Here, we piloted this Norway-specific definition to the population based on a limited set of key words (e.g., recycling, environment [outside the health and safety area[8]], energy, etc.).

The Norwegian (NUS) code for environment and pollution studies was used to identify green educations (the same as ISCED-97 education fields 0521 [environmental sciences], 0712 [environmental protection technology], 0714 [electronics and automation], 0522 [natural environments and wildlife], and 0713 [electricity and energy]). The identification procedure only included higher degrees beyond the level of a bachelor's degree.

We also dropped the following generic definitions from the ISCED because they are very broad and numerous and only include a tiny minority in our test batch of green educations:

- 311: Economics
- 714: Electronics and automation
- 1032: Protection of persons and property

To define green skills via education, we used both the Norwegian (NUS) codes and the basic ISCED codes. The NUS codes are more specific (see also the introductory section on methodology).

5.2.1 Identification of eco-innovators in Norway

As indicated, the Norwegian case differs slightly from the other Nordic countries in terms of the lens required to identify eco-innovators. The first aspect is coverage: The survey was sent to a full sample of enterprises with 50 or more employees, while a random stratified sample was taken for firms with between 5 and 49 employees. We note that this sample is more complete than those usually employed by the CIS, where the

[5] This definition is based on the American SOC 2010. SOC 2010 is not used in the EU (or the rest of the world), which uses ISCO-08 instead. At the same time, ISCO-08 is not as nuanced as SOC 2010 (or as nuanced as the corresponding Norwegian standard correspondence).

[6] Specifically, 17-2199.10 (wind energy engineers) were reallocated to 3131 (power production plant operators) instead of the more general 2149 (engineering professionals not elsewhere classified).

[7] E.g., business services agents, see the appendix.

[8] In Norwegian, *miljø* (environment) also includes vocations related to some health-occupations (e.g., *miljøarbeider (environmental worker*). these are excluded. See the appendix for the full list of occupations

cut-off for most European countries is firms with at least 10 employees.[9] The second aspect involves the instrument used to measure eco-innovation. In short, Statistics Norway opted to not implement the EU-harmonized module on environmental innovators. In part, this decision has been defended based on the observation that Norwegian firms already report overlapping information in the CIS/R&D surveys.

The Norwegian CIS reports on the environmental effects of innovation. This was our main variable for green innovation. The target variable was based on the EBEN question, which indicates how important environmental effects were to the innovation process (particularly the development of new products or processes) during the reference period [10] The measure we used were cases where the reduction of environmental effects was reported to be highly important to the development of new products or processes.

In addition, the Norwegian R&D survey (2013), which Statistics Norway implemented alongside the CIS survey, provides a valuable, complementary measure for eco-innovations. R&D expenditures provide a clear indication that a firm is engaged in innovative activities. We took advantage of the fact that Statistics Norway (cf. Denmark) asks firms to report the R&D expenditures that they allocate to (i) renewable energy and (ii) CO2-mitigation technologies. A variable for green R&D was created for firms that reported their own R&D as being dedicated to either (or both) of the two cases ("enerfor" or "milco2").[11] This measure by definition excludes non-R&D innovation, such as organizational innovation and thus can be seen as a more conventional measure of eco-innovation.

In sum, the approach employed in the Norwegian case captures both a measure of the basic eco-innovation activity (in terms of R&D expenditures) as well as a measure of the designed effect of the innovation (in terms of the potential to mitigate environmental effects).

5.3 Results

Table 9 describes the extent and distribution for the measures introduced above. It compares the three approaches—for vocation, for education, and for industrial activity—we used to take stock of green skills. The first column (*green vocation*) applies the definition as found in Vona et al. (2015.), while the second (*green GONST*) applies the common, restrictive definition. The third definition (*green Norway*) utilizes the more detailed categorization found in Norway to differentiate further using keywords (see appendix).

There was considerable variation depending on the measures used. Focusing first on vocations, we see that the broad identification suggests that 5.3% of the active labor-force are employed in green occupations, while according to the two more restrictive measures, the corresponding share is 0.3%. The rankings are in line, but a number of differences emerge when broken down at the regional level.

[9] See also: https://ssb.no/a/english/kortnavn/innov_en/about.html
[10] The question reads, "*Hvor viktig var å redusere miljømessige effekter for utvikling av nye produkter eller prosesser*"
[11] The question reads, "*Kostnader til egenutført FoU brukt på fornybar energi i 2013. Prosent (hvis fou bruk)"*

Table 9. Share of total employees with green skills in Norway in 2013.

		Occupation-based			Education-based		Activity-based
	Employment	Green vocation	Green GONST	Green Norway	Green	Green Norway	EGSS
Østfold	116,528	4.6%	0.3%	0.2%	0.1%	0.1%	0.7%
Akershus	256,097	5.2%	0.2%	0.2%	0.2%	0.2%	0.5%
Oslo	441,822	4.1%	0.1%	0.2%	0.2%	0.2%	0.3%
Hedmark	84,791	4.2%	0.4%	0.4%	0.2%	0.2%	0.6%
Oppland	85,778	4.0%	0.4%	0.4%	0.1%	0.2%	0.7%
Buskerud	123,725	5.8%	0.3%	0.4%	0.1%	0.2%	0.5%
Vestfold	103,833	5.0%	0.2%	0.1%	0.1%	0.1%	0.5%
Telemark	75,048	5.2%	0.4%	0.4%	0.3%	0.3%	0.7%
Aust-Agder	48,089	4.6%	0.4%	0.4%	0.1%	0.2%	0.5%
Vest-Agder	86,638	7.1%	0.3%	0.3%	0.1%	0.1%	0.5%
Rogaland	243,425	7.8%	0.3%	0.2%	0.1%	0.1%	0.5%
Hordaland	254,691	6.3%	0.2%	0.3%	0.1%	0.1%	0.4%
Sogn og Fjordane	53,775	4.5%	0.3%	0.5%	0.3%	0.3%	0.7%
Møre og Romsdal	128,521	6.3%	0.3%	0.3%	0.1%	0.1%	0.4%
Sør-Trøndelag	159,591	4.7%	0.2%	0.3%	0.2%	0.3%	0.4%
Nord-Trøndelag	61,903	5.2%	0.4%	0.2%	0.2%	0.2%	0.5%
Nordland	114,558	4.6%	0.4%	0.5%	0.1%	0.1%	0.5%
Troms	81,695	4.0%	0.3%	0.4%	0.1%	0.1%	0.5%
Finnmark	37,116	4.5%	0.5%	0.6%	0.2%	0.3%	0.6%
Total	2,557,624	5.3%	0.3%	0.3%	0.2%	0.2%	0.5%

In sum, the measures for green vocations indicate a band of between 7,700 (0.3%) and 134,600 employees (5.3%) working in Norway in green occupations in 2013. This range is admittedly broad. A comparison of the different measures, however, suggests that the number is probably closer to the floor of this band. The identification of green education suggests that 0.2% of the Norwegian workforce hold higher degrees in the green fields, while about 12,800 (0.5%) employees work in green firms (EGSS).

The definitions are as clear-cut as possible (e.g., the requirement of at least a university degree in a green education). They have the virtue of providing a reliable and comparable starting point. This first step suggests that an identification strategy based on transposing occupation and/or educational codes is restrictive and possibly can best be seen as a baseline to understand what constitutes a green firm. We can use this baseline as an informed starting point to hypothesize where the real value is to be found. A further virtue of this baseline is that it is comparable across time, across regions, and across countries. In this light, the table indicates a number of regional differences in Norway. There seem to be relatively more green vocations in the regions involved in the brown economy, including Rogaland, Hordaland, Vest-Agder, and Møre og Romsdal. These four counties all have major oil-related industries, both up- and down-stream.

5.3.1 Firm level

We turn from the employee-level to the firm-level association with the green economy. Table 10 reports on the population of Norwegian enterprises and the share of employees that fall into the same vocational and educational groups as above. It focuses on the population of enterprises that have at least one employee with either a green education and/or a green vocation. It explores the proposition that such firms are green firms. Based on this (strong) assumption, it tallies all employees in these firms and examines the shares of their employees in terms of the indicators for green educations, green occupations, and green activities that were previously introduced.

Table 10. Share and number of firms with employees with green skills in Norway in 2013.

		Occupation-based			Education-based		Activity-based
	Firms	Green	Green GONST	Green Norway	Green	Green Norway	EGSS
Østfold	12,043	12.6%	0.2%	0.3%	0.4%	0.5%	0.3%
Akershus	24,180	14.4%	0.3%	0.3%	0.7%	0.8%	0.2%
Oslo	33,789	16.3%	0.3%	0.3%	1.0%	1.0%	0.1%
Hedmark	9,069	12.1%	0.2%	0.4%	0.7%	0.7%	0.2%
Oppland	9,915	10.8%	0.3%	0.4%	0.8%	0.8%	0.3%
Buskerud	13,014	13.9%	0.4%	0.4%	0.7%	0.7%	0.3%
Vestfold	10,694	14.6%	0.1%	0.3%	0.6%	0.6%	0.3%
Telemark	7,425	13.5%	0.4%	0.6%	1.3%	1.3%	0.3%
Aust-Agder	4,845	13.7%	0.2%	0.4%	0.6%	0.6%	0.2%
Vest-Agder	7,509	14.0%	0.3%	0.4%	0.7%	0.7%	0.3%
Rogaland	17,949	17.3%	0.4%	0.5%	0.8%	0.8%	0.2%
Hordaland	18,624	15.7%	0.3%	0.4%	0.6%	0.7%	0.2%
Sogn og Fjordane	5,730	12.2%	0.3%	0.5%	1.2%	1.3%	0.3%
Møre og Romsdal	11,078	16.4%	0.4%	0.4%	0.6%	0.7%	0.2%
Sør-Trøndelag	12,075	15.3%	0.4%	0.4%	0.9%	1.0%	0.2%
Nord-Trøndelag	6,438	11.3%	0.1%	0.4%	1.0%	1.0%	0.3%
Nordland	10,233	13.8%	0.5%	0.5%	0.7%	0.8%	0.2%
Troms	6,736	14.5%	0.3%	0.5%	0.5%	0.5%	0.4%
Finnmark	3,785	13.1%	0.4%	0.6%	1.1%	1.2%	0.4%
Total	225,131	14.5%	0.3%	0.4%	0.8%	0.8%	0.2%

The relative strength of these measures—and moreover, their rankings by region—change when we consider this subpopulation. The table supports the supposition that firms that hired at least one employee with green credentials tend to include a higher share of other employees in the standard definition of a green occupation: 14.5% on average as opposed to 5.3% for the total population of firms. The share based on the more refined definition (*green Norway*) is also slightly higher, as are both education-based measures. However, this lens does not appreciably increase the overall share of firms identified according to industrial activities designated as green (EGSS). This makes sense, as all EGSS firms tend to figure in both the total and the subpopulation. The implication is that industrial classifications do not add very much to interpretations based on occupational and/or educational markers.

5.3.2 Regional level

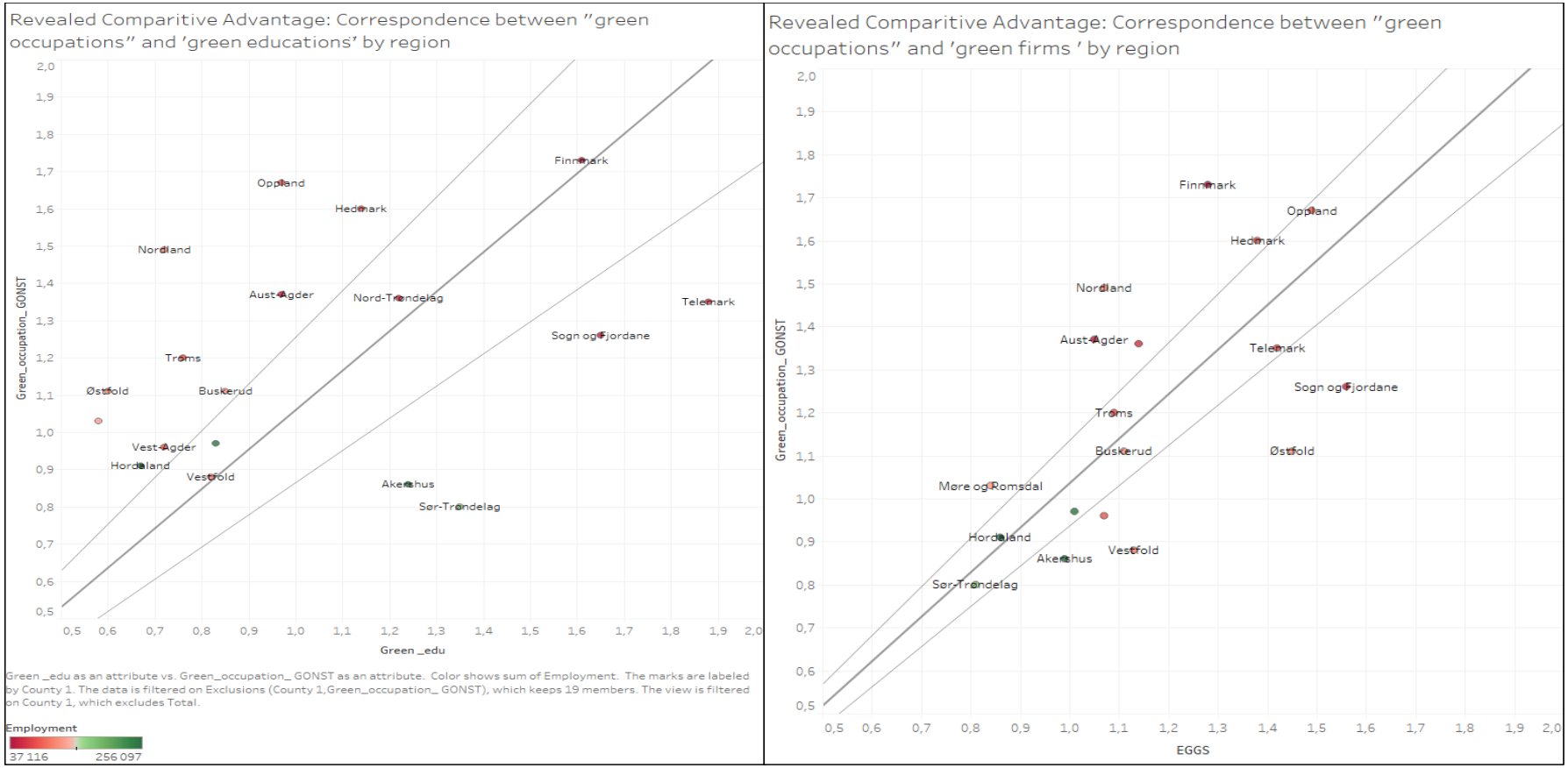
What regional differences emerge in Norway based on these measures? To elucidate this, we transformed the shares in the previous tables to a more easily understandable indicator: revealed comparative advantage (RCA). The RCA indicator takes a region's share of a given measure (e.g., employees with a green education) and compares it to what the region should have given the region's share of total employment. This yields a more easily interpreted measure in which a score of 1.1 basically means that the region has 10% more of the measure (e.g., employees with a green education) than what would be expected given the region's overall share of total employment.

Table 11. Regional specialization patterns in Norway.

		Occupation-based			Education-based		Activity-based
	Employment	Green	Green GONST	Green Norway	Green	Green Norway	EGSS
Østfold	116,528	0.87	1.11	0.82	0.60	0.66	1.45
Akershus	256,097	0.99	0.86	0.53	1.24	1.16	0.99
Oslo	441,822	0.78	0.54	0.62	1.18	1.13	0.61
Hedmark	84,791	0.80	1.60	1.41	1.14	1.05	1.38
Oppland	85,778	0.76	1.67	1.46	0.97	0.99	1.49
Buskerud	123,725	1.09	1.11	1.41	0.85	0.92	1.11
Vestfold	103,833	0.95	0.88	0.41	0.82	0.73	1.13
Telemark	75,048	0.99	1.35	1.59	1.88	1.85	1.42
Aust-Agder	48,089	0.87	1.37	1.35	0.97	0.92	1.05
Vest-Agder	86,638	1.34	0.96	1.22	0.72	0.74	1.07
Rogaland	243,425	1.47	0.97	0.73	0.83	0.86	1.01
Hordaland	254,691	1.19	0.91	1.06	0.67	0.73	0.86
Sogn og Fjordane	53,775	0.86	1.26	1.74	1.65	1.60	1.56
Møre og Romsdal	128,521	1.19	1.03	1.11	0.58	0.64	0.84
Sør-Trøndelag	159,591	0.90	0.80	0.97	1.35	1.55	0.81
Nord-Trøndelag	61,903	0.98	1.36	0.85	1.22	1.22	1.14
Nordland	114,558	0.87	1.49	1.91	0.72	0.70	1.07
Troms	81,695	0.76	1.20	1.42	0.76	0.64	1.09
Finnmark	37,116	0.85	1.73	1.97	1.61	1.48	1.28
Total	2,557,624	1.00	1.00	1.00	1.00	1.00	1.00

The pattern in the comparable advantages that emerged was not consistent across our different measures of green skill. The following figure compares the measures between education and occupation (left side) and occupation and green firms (right side).

Figure 9. Revealed comparative advantage of Norwegian regions.



We note that a value of 1.0 on either axis corresponds to the expected concentration for that measure given the size of that county. Counties that fall within the 1.0 x 1.0 square are therefore less specialized than average in terms of green employees (as defined by green educations and green occupations) or in terms of green firms (EGSS). The relationship between green educations and green occupations (left side) is not strong (maximum correlation at 0.30) and is all over the map at the county level (four counties demonstrated a correlation between green education and green occupations within our confidence level). The relationship between green firms and green occupations is stronger (a correlation of 0.70) and tighter.

The comparison of RCAs does provide a graphical presentation of which counties are more (or less) specialized. Finnmark is consistently above the expected levels for all measures. Sogn og Fjordane and Telemark are above average in terms of green educations, but below average in terms of green occupations and green firms. Sør Trøndelag is relatively strong in terms of educations, but less so in occupations and firms, while Hordaland tends to be less specialized along all measures, although it is more specialized when using the broader measure for occupations.

The maps bring the differences between specialization patterns into relief. In the maps, red represents the weakest specialization, and green represents the strongest specialization. The two maps present the RCAs for green educations (Figure 10) and green occupations (Figure 11), while the map below presents green firms. These figures demonstrate that the distribution of green educations (using the GONST specification) does not correlate strongly correlate with green occupations and/or green firms, aside from the exceptions already noted (e.g., Finnmark).

Figure 10. Revealed comparative advantage of green educations in regions in Norway.

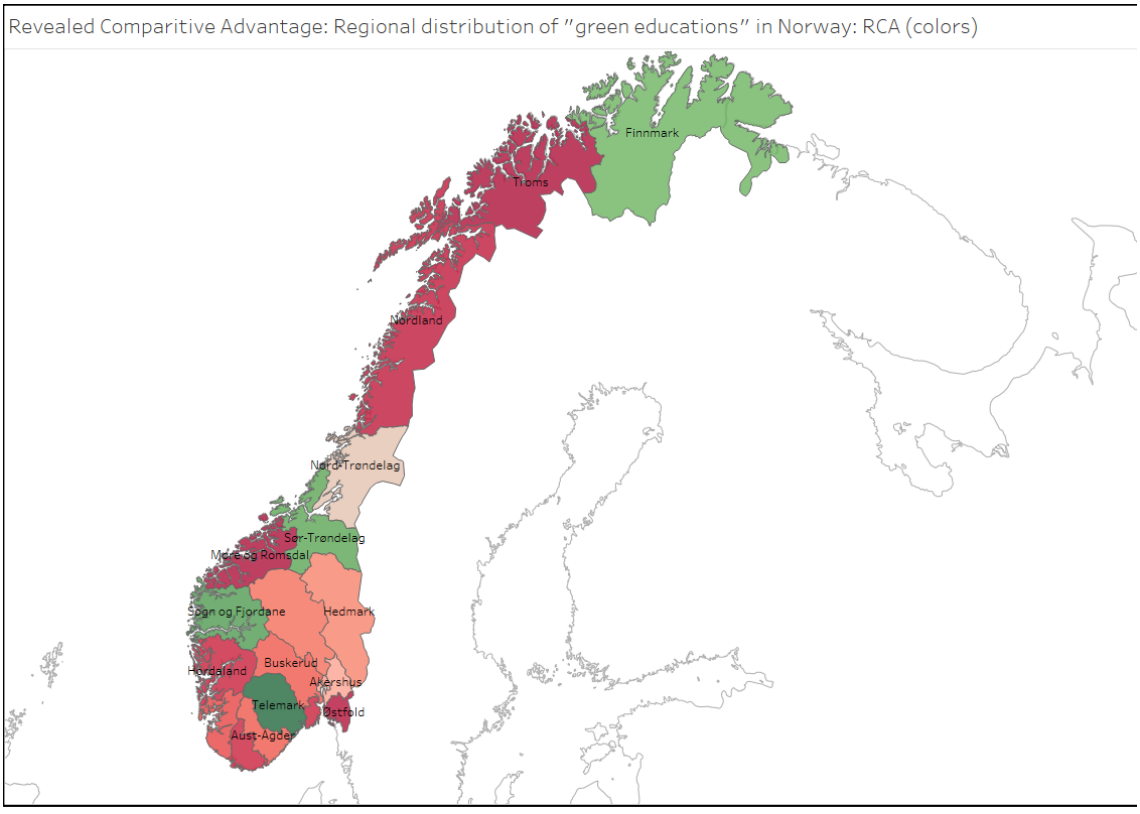


Figure 11. Revealed comparative advantage of green occupations in regions in Norway.

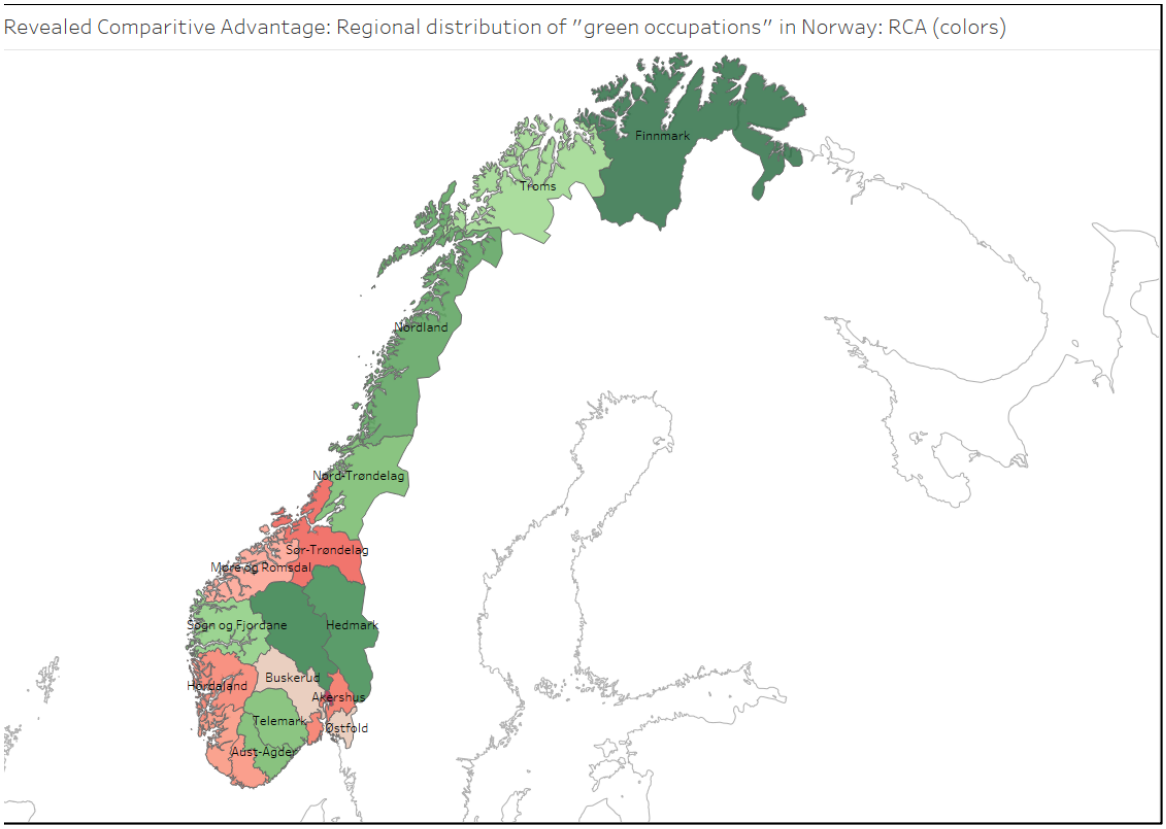
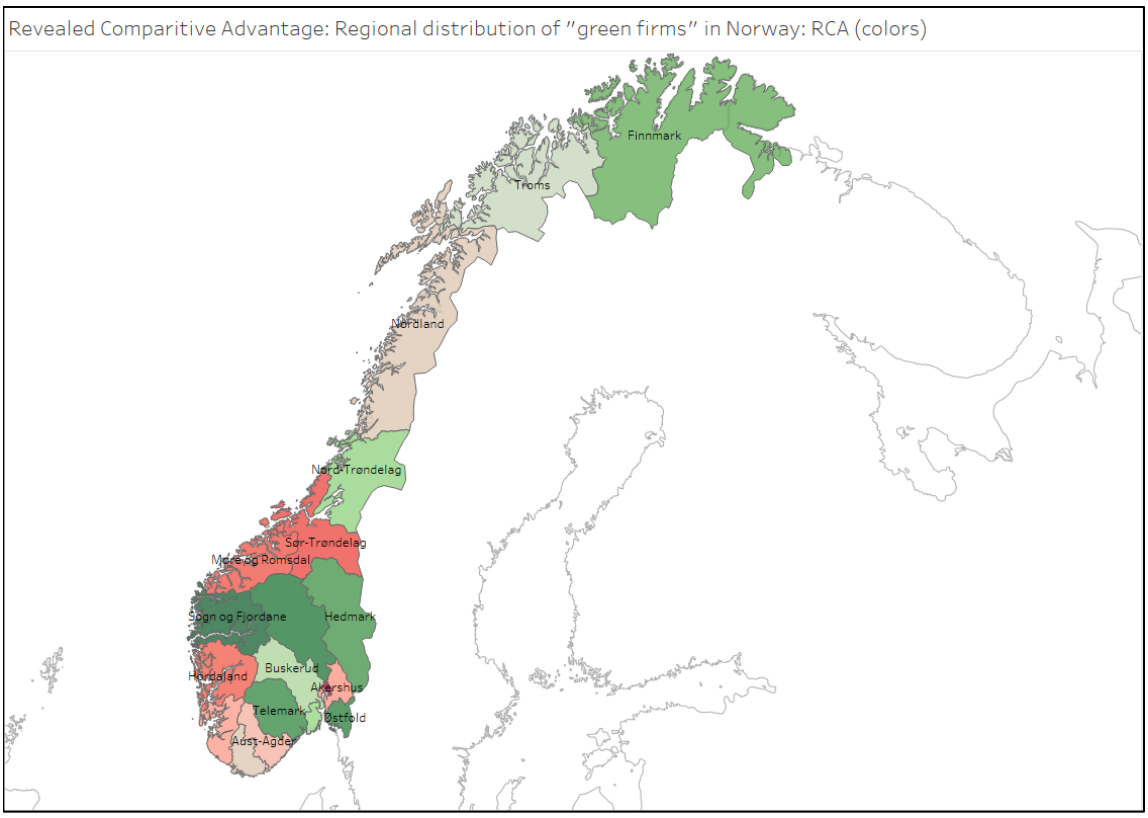


Figure 12. Revealed comparative advantage of green firms in regions in Norway.



The correlation between green firms and green occupations is generally stronger in different regions of the country.

5.3.3 Eco-innovators

This section provides a look at the relationship between the innovation measures we proposed for capturing green innovations in Norway and the characteristics of green firms (based on EGSS) and their employees (based on green occupations and green educations).

In order to analyze what factors contribute to the probability that a firm is an active eco-innovator. This activity can be measured in two distinct ways, as introduced earlier: It can be measured by (i) the importance the firm ascribes to the environmental effects of its innovation efforts (either in products or processes) and (ii) the portion of R&D expenditure a firm allocates to addressing renewable energy and/or CO2-mitigation technologies. For the purposes of this presentation, we will call the first *green innovation* and the second *green R&D*. We also note that the two clearly overlap even if the populations of the two surveys are slightly different.

In terms of green innovation, 10% of respondent firms reported that the potential environmental effects were highly important to their product and process innovation. In terms of green R&D, a share of 3.5% of respondent firms report allocated R&D expenditures to renewable energy and/or CO2-mitigation technologies. Table 12 presents the shares and LQs of green innovation and green R&D at the regional level.

Table 12. Green innovators in Norway.

			Green innovation		Green R&D	
	Firms in the CIS	Firms in the R&D survey	In region	LQ	In region	LQ
Østfold	232	181	8.2%	0.82	6.6%	1.91
Akershus	599	494	8.3%	0.83	4.0%	1.17
Oslo	1,201	922	9.4%	0.94	3.1%	0.91
Hedmark	143	120	9.1%	0.91	3.3%	0.96
Oppland	177	135	13.6%	1.35	2.2%	0.64
Buskerud	300	214	11.7%	1.16	4.7%	1.35
Vestfold	251	186	10.8%	1.07	4.8%	1.40
Telemark	171	125	6.4%	0.64	4.0%	1.16
Aust-Agder	112	87	5.4%	0.53	4.6%	1.33
Vest-Agder	193	142	9.3%	0.93	7.0%	2.03
Rogaland	645	526	11.6%	1.16	2.5%	0.71
Hordaland	539	413	11.3%	1.13	3.1%	0.91
Sogn og Fjordane	134	103	12.7%	1.27	1.9%	0.56
Møre og Romsdal	337	305	11.0%	1.10	1.3%	0.38
Sør-Trøndelag	369	277	7.9%	0.78	3.6%	1.04

Nord-Trøndelag	141	109	7.8%	0.78	6.4%	1.85
Nordland	224	173	8.9%	0.89	2.3%	0.67
Troms*	174	114	17.8%	1.78	1.8%	0.51
Finnmark	73	53	8.2%	0.82	1.9%	0.54
Total	6,015	4,679	10.0%	1.00	3.5%	1.00

* The importance of green innovation in Troms is not clear: It is much higher than would be expected when compared with neighboring regions.

5.3.4 Eco-innovations and green skills

In the following Table 13, the dependent variable is a dichotomous variable that takes the value of 1 for firms reporting that addressing environmental effects were highly important to their product and process innovations. The table explores different ways of measuring green skills, and controls for share of employees with higher education, size, region, and industry as well.

Table 13. Logistic regression of the firms that say environmental effects are highly important for their innovations (either in products or processes).

VARIABLES	(1) bl	(2) green_gonst	(3) green_edu	(4) green_edu_norw	(5) EGSS
green_gonst		0.010*			
		(0.006)			
green_edu			0.101***		
			(0.024)		
green_edu_norw				0.105***	
				(0.025)	
EGSS					1.460***
					(0.243)
high_edu	0.003	0.003	0.001	0.001	0.004
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
logemployees	0.268***	0.270***	0.269***	0.271***	0.286***
	(0.036)	(0.036)	(0.036)	(0.036)	(0.036)
Østfold	-0.037	-0.043	-0.044	-0.038	-0.086
	(0.372)	(0.372)	(0.372)	(0.372)	(0.374)
Akershus	0.095	0.089	0.098	0.094	0.058
	(0.317)	(0.317)	(0.317)	(0.317)	(0.318)
Oslo	0.219	0.220	0.238	0.220	0.215
	(0.296)	(0.296)	(0.296)	(0.296)	(0.297)
Hedmark	0.071	0.057	0.057	0.061	0.021
	(0.407)	(0.407)	(0.407)	(0.407)	(0.409)
Oppland	0.612*	0.588	0.613*	0.613*	0.578
	(0.358)	(0.358)	(0.358)	(0.358)	(0.359)
Buskerud	0.264	0.265	0.257	0.269	0.270
	(0.336)	(0.336)	(0.336)	(0.336)	(0.337)
Vestfold	0.348	0.341	0.346	0.340	0.336
	(0.348)	(0.348)	(0.348)	(0.348)	(0.349)
Telemark	-0.403	-0.406	-0.418	-0.415	-0.379
	(0.439)	(0.439)	(0.439)	(0.439)	(0.440)
Aust-Agder	-0.303	-0.317	-0.301	-0.334	-0.353
	(0.504)	(0.504)	(0.504)	(0.505)	(0.506)
Rogaland	0.280	0.285	0.270	0.275	0.327
	(0.299)	(0.299)	(0.299)	(0.299)	(0.300)
Hordaland	0.350	0.351	0.360	0.359	0.375
	(0.305)	(0.305)	(0.305)	(0.305)	(0.306)
Sogn og Fjordane	0.301	0.291	0.267	0.266	0.284
	(0.401)	(0.401)	(0.401)	(0.401)	(0.402)
Møre og Romsdal	0.265	0.270	0.252	0.256	0.284

	(0.323)	(0.324)	(0.324)	(0.324)	(0.325)
Sør-Trøndelag	0.105	0.111	0.040	0.070	0.129
	(0.338)	(0.338)	(0.341)	(0.340)	(0.339)
Nord-Trøndelag	-0.025	-0.030	-0.031	-0.026	-0.046
	(0.417)	(0.417)	(0.417)	(0.417)	(0.418)
Nordland	0.083	0.079	0.086	0.088	0.116
	(0.372)	(0.372)	(0.372)	(0.372)	(0.373)
Troms	1.015***	1.015***	1.012***	1.008***	1.038***
	(0.341)	(0.342)	(0.342)	(0.342)	(0.343)
Finnmark	0.023	0.032	0.022	0.019	0.008
	(0.542)	(0.542)	(0.542)	(0.542)	(0.545)
High-technology manufacturing	-1.026*	-1.023*	-0.977*	-0.938*	-1.020*
	(0.530)	(0.530)	(0.530)	(0.531)	(0.530)
Medium high-technology manufacturing	0.882***	0.890***	0.870***	0.921***	0.907***
	(0.204)	(0.204)	(0.205)	(0.206)	(0.205)
Medium low-technology manufacturing	0.589***	0.597***	0.590***	0.628***	0.613***
	(0.210)	(0.211)	(0.211)	(0.212)	(0.211)
Low-technology manufacturing	0.336*	0.346*	0.334	0.369*	0.370*
	(0.204)	(0.204)	(0.205)	(0.206)	(0.205)
Primary, utilities and construction	0.132	0.091	0.103	0.151	-0.089
	(0.186)	(0.189)	(0.187)	(0.188)	(0.195)
High-tech, knowledge-intensive services	-0.458**	-0.457**	-0.448**	-0.405*	-0.456**
	(0.216)	(0.216)	(0.218)	(0.219)	(0.217)
Knowledge-intensive financial services	-1.963***	-1.962***	-1.897***	-1.866***	-1.970***
	(0.524)	(0.524)	(0.525)	(0.525)	(0.524)
Other knowledge-intensive services	-1.668***	-1.666***	-1.597***	-1.571***	-1.667***
	(0.473)	(0.473)	(0.474)	(0.474)	(0.473)
Other services	0.050	0.057	0.052	0.088	0.078
	(0.203)	(0.203)	(0.204)	(0.205)	(0.204)
Constant	-3.595***	-3.613***	-3.573***	-3.623***	-3.708***
	(0.351)	(0.352)	(0.352)	(0.353)	(0.354)
Observations	5,247	5,247	5,247	5,247	5,247
Pseudo *R* squared	0.0579	0.0586	0.0630	0.0624	0.0669

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$ Note: Vest-Agder was used as reference for regions, and knowledge-intensive market services was used as a reference for industries, as both were closest to the average.

All measurements for green skills were positively correlated to the probability that the firm reported that environmental effects were important to their product and/or process innovations. This helps to confirm that our different approaches capture a certain degree and kind of green skills. More generally, firm size was also consistently positive and high for all measures, indicating that larger firms were more likely to report eco-innovation.

The marginal effects (not reported here) of the coefficients can be used to indicate the size of this effect. Model 2 suggests that a firm is 1.5 percentage points more likely to eco-innovate if it has employees with a green vocation. Similarly, model 3 shows that the incidence of eco-innovation is 6 percentage points higher if the firm has employees with green educations. Model 4, in turn, indicates a firm is 7 percentage points more likely to eco-innovate if the firm has employees with green educations based on the more accurate Norwegian definition. In model 5, the propensity for eco-innovation is 12 percentage points higher for firms in an EGSS industry. In terms of regional differences, we found that compared to Vest-Agder, Troms and Oppland were significantly more active in innovation according to the measures defined here.

We now turn to a complementary measure of green innovation—namely, the likelihood that a firm allocated resources to conduct green R&D. In the following Table 14, green R&D is a binary dependent variable that takes the value of 1 if the firm reports allocating R&D expenditures either to (i) renewable energy and/or (ii) CO2-mitigation technologies. R&D expenditures is a traditional measure of innovation activity that has the benefit of putting a value on the input going into innovative activities at the firm. However, this standard measure has also been criticized as excluding a whole range of innovation activities that do not involve formal R&D. Here, it is presented as a reliable baseline to help us better understand green innovation.

Table 14. Logistic regression of firms that allocate R&D expenditures to (i) renewable energy or (ii) CO2-mitigation technologies.

VARIABLES	(1) bl	(2) green_gonst	(3) green_edu	(4) green_edu_norw	(5) EGSS
green_gonst		1.063*** (0.268)			
green_edu			0.923*** (0.226)		
green_edu_norw				1.038*** (0.232)	
EGSS					1.582*** (0.410)
high_edu	0.039*** (0.004)	0.038*** (0.004)	0.035*** (0.004)	0.036*** (0.004)	0.041*** (0.004)
logemployees	0.526*** (0.068)	0.480*** (0.070)	0.364*** (0.078)	0.352*** (0.078)	0.551*** (0.069)
Østfold	1.232** (0.491)	1.207** (0.496)	1.254** (0.495)	1.249** (0.493)	1.176** (0.494)
Akershus	-0.058 (0.435)	-0.012 (0.439)	-0.030 (0.440)	-0.090 (0.438)	-0.137 (0.437)
Oslo	-0.501 (0.408)	-0.480 (0.412)	-0.440 (0.412)	-0.473 (0.410)	-0.541 (0.409)
Hedmark	0.638 (0.636)	0.593 (0.640)	0.547 (0.639)	0.530 (0.639)	0.556 (0.640)
Oppland	-0.699 (1.077)	-0.843 (1.083)	-0.823 (1.082)	-0.860 (1.082)	-0.719 (1.079)
Buskerud	0.435 (0.519)	0.440 (0.519)	0.355 (0.524)	0.371 (0.522)	0.411 (0.522)
Vestfold	0.655 (0.545)	0.638 (0.547)	0.602 (0.549)	0.545 (0.549)	0.561 (0.549)
Telemark	0.872 (0.600)	0.823 (0.604)	0.697 (0.605)	0.732 (0.602)	0.948 (0.602)
Aust-Agder	0.786 (0.661)	0.785 (0.660)	0.792 (0.660)	0.621 (0.671)	0.710 (0.661)
Vest-Agder	0.891* (0.522)	0.933* (0.525)	0.863 (0.528)	0.865 (0.526)	0.901* (0.524)
Rogaland	-0.837* (0.486)	-0.786 (0.490)	-0.806* (0.486)	-0.853* (0.485)	-0.761 (0.487)
Hordaland	0.031 (0.460)	0.065 (0.463)	0.085 (0.464)	0.072 (0.462)	0.037 (0.461)
Sogn og Fjordane	0.301 (0.815)	0.215 (0.820)	0.060 (0.825)	0.027 (0.825)	0.298 (0.816)
Møre og Romsdal	-0.426 (0.630)	-0.430 (0.638)	-0.453 (0.634)	-0.445 (0.633)	-0.412 (0.632)

Nord-Trøndelag	1.316**	1.262**	1.190**	1.197**	1.310**
	(0.574)	(0.580)	(0.580)	(0.578)	(0.577)
Nordland	0.065	-0.025	0.019	0.043	0.152
	(0.696)	(0.700)	(0.699)	(0.697)	(0.697)
Troms	-0.267	-0.358	-0.232	-0.214	-0.284
	(0.811)	(0.816)	(0.814)	(0.811)	(0.812)
Finnmark	-0.065	0.006	-0.097	-0.015	0.032
	(1.096)	(1.094)	(1.106)	(1.094)	(1.099)
High-technology manufacturing	-0.100	-0.064	-0.058	-0.068	-0.073
	(0.671)	(0.667)	(0.669)	(0.669)	(0.672)
Medium high-technology manufacturing	1.566***	1.534***	1.361***	1.370***	1.627***
	(0.382)	(0.384)	(0.389)	(0.387)	(0.385)
Medium low-technology manufacturing	1.221***	1.184***	1.123**	1.061**	1.286***
	(0.434)	(0.437)	(0.437)	(0.437)	(0.437)
Low-technology manufacturing	0.781	0.777	0.673	0.636	0.883*
	(0.475)	(0.477)	(0.479)	(0.479)	(0.478)
Primary, utilities and construction	1.458***	1.093***	1.192***	1.168***	1.276***
	(0.340)	(0.361)	(0.348)	(0.348)	(0.350)
Knowledge-intensive market services	0.680**	0.600*	0.501	0.425	0.679**
	(0.322)	(0.324)	(0.326)	(0.329)	(0.322)
Knowledge-intensive financial services	-1.381*	-1.365*	-1.269*	-1.281*	-1.380*
	(0.761)	(0.761)	(0.762)	(0.761)	(0.761)
Other knowledge-intensive services	-1.313*	-1.306*	-1.321*	-1.374*	-1.311*
	(0.758)	(0.757)	(0.759)	(0.759)	(0.758)
Other services	0.829*	0.750	0.691	0.674	0.889*
	(0.492)	(0.495)	(0.495)	(0.495)	(0.494)
Constant	-7.933***	-7.708***	-7.138***	-7.052***	-8.164***
	(0.612)	(0.615)	(0.638)	(0.634)	(0.624)
Observations	4,105	4,105	4,105	4,105	4,105
Pseudo *R*-squared	0.163	0.174	0.175	0.178	0.172

Standard errors in parentheses. *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Note: Sør-Trøndelag was used as a reference for regions, and high-tech, knowledge-intensive services was used as a reference for industries, as both were closest to the average.

As a baseline to help us better understand green innovation, green R&D provides a complementary view to the one above. Not surprisingly, green R&D was characterized by increasing firm size, as was the case with eco-innovation above. The impact of firms with more highly educated employees is, however, strongly positive and significant.

We found more regional variation in the case of green R&D. In terms of regional differences, the strength of Troms in the analysis above disappears, turning negative. When we considered R&D expenditures, Troms was below average, although most results were not robust with our controls in this setting. Compared to Sør-Trøndelag, which is closest to the mean, there is a significantly higher incidence of green R&D in Nord-

Trøndelag, Østfold, and Vest-Agder, although the results are not as robust. On the other hand, Rogaland has a similarly low coefficient as Troms in this model, but unlike Troms, it is significant.

The effects and levels of robustness can be revisited in view of the marginal effects. At this point, we can draw the following general observations from these results. As above, a presentation of marginal effects can be used to say something about the size of the effects in the model. In model 2, if a firm has employees with green vocations, their chance to have green R&D expenditures is 3.4 percentage points higher. In model 3, there the chance for a firm to make green R&D expenditures is 2.9 percentage points higher if the firm has employees with green educations. In model 4, there a firm is 3.2 percent points more likely to have green R&D expenditures if they have employees with green educations as based on the more accurate Norwegian definition. In model 5, the chance for green R&D expenditures is 5 percentage points higher if the firm is in an EGSS industry.

5.4 Country conclusion

The measures used here are, although not perfect, useful for presenting and comparing the relationship between green skills, innovation, and regional differences in different contexts. In particular, the overall picture illuminates the intersection of what constitutes “green” in terms of industrial activity, what constitutes “innovation” in terms of firm-level activities, and what can be said to constitute “growth” at a more macro-level.

Education does not map directly to skill, nor does the title of a degree correspond on a one-to-one basis to green technologies. Still, we think analyses should encompass an attempt to use degree orientation/level as one starting point. Here, we chose a restricted but unequivocal classification of green degrees to get a sense of the regional breakdown.

The CIS offers several avenues by which to study green innovations and skills. Not all countries use the same questions despite harmonization. In the absence of the module on "Innovations with environmental benefits," Norway uses a question on the importance of environmental aims to product/process innovation.

R&D investments are fundamental but not perfect indicators. The Norwegian survey provides at least two relevant fields. The ones demonstrated here are the (continuous) variables on R&D outlays on renewable energy (similar to ECOREP) and the other on CO2 mitigation (similar to ECOENO).

6 Country report: Sweden

6.1 Methodology

We based our analyses on the Swedish matched employer-employee database (LISA) and the Swedish contribution to the CIS. Both datasets used here refer to the reference year 2014. The CIS 2014 includes a number of variables providing information on whether firms have introduced innovations with beneficial effects on the environment (i.e., eco-innovations). In total, the CIS 2014 had a sample size of 8,125 firms. Because the CIS includes neither population data nor geographically stratification, using the CIS to analyze spatial distributions can be problematic. We nonetheless show some of this evidence but highlight that the usefulness of the CIS is greatest when used in our regression analyses. Although there is an R&D survey for Sweden as is the case in Denmark and Norway, specific questions on environmentally oriented R&D have not been asked. We therefore have no opportunity to identify green R&D.

To identify green skills, we followed the methodologies used in the other countries and used an education-based approach, an activity-based approach, and an occupation-based approach. Because data sources differ somewhat between countries, we strived to keep definitions as close as possible.

Sweden consists of three NUTS 1 regions, eight NUTS 2 regions, and 21 NUTS 3 regions (provinces or *län*). As for the other countries, we used the NUTS 3 regions.

6.1.1 Approaches to Identifying green skills

6.1.1.1 Activity-based approaches

The EGSS classification can be transferred from NACE to the SNI (*Standard för svensk näringsgränsindelning*). The Swedish definition of EGSS firms is therefore fully compatible with the EU definition.

6.1.1.2 Education-based approaches

We identified green skills based on educational data by an approach similar to the one used for Denmark. Specifically, we chose tertiary subjects that have a direct connection to environmental topics. Sweden, however, uses its own nationally adapted version of the ISCED classification called SUN (*Svensk Utbildningsnomenklatur*). While still based on ISCED, SUN can occasionally differ from the ISCED substantially and includes or excludes specific subjects that have been found to be particularly relevant or irrelevant in Sweden. To cover the fields explained in Section 3.1.2 as accurately as possible, we included the fields in biology with a specific focus on environmental issues (SUN 422) and environmental sciences (SUN 850). Since the Swedish LISA database does not provide information on SUN levels below the fourth digit, we were unable to provide a more detailed version by searching for environmentally relevant subjects in other classifications. Therefore, our identification of green skills comes close to a broad education-based definition, although we were not able to establish a more specific classification.

6.1.1.3 Occupation-based approaches

We identified green occupations based on Vona et al.'s work (2015), which we adapted to the ISCO classification. Then, we mapped the ISCO classification to the Swedish implementation SSYK 2012 (*Sysselsättningskategorier*). While, in principle, there are relatively clear crosswalk tables, their transfer from Vona et al. (2015) to the ISCO resulted in the inclusion of fairly general categories that also include green

occupations. We have therefore implemented a second occupational definition that excludes such broad categories. More details can be found in the appendix.

6.1.2 Identification of eco-innovators in Sweden

To identify environmentally innovative firms, we included innovations that have environmental benefits for users (e.g., windturbines), the firm itself (e.g., reduced Co2 emissions), or both. The identification of eco-innovative firms is based on the CIS 2014. This survey included a voluntary module on innovations with benefits for the environment. In the Swedish survey, they asked whether the firm had introduced changes or innovations with one or more environmental benefits in the period from 2012–2014. The benefits can be for the firm itself or produced during the use of the product or service by the end-user (see the appendix for more details).

6.2 Results

6.2.1 Green skills

Table 15 presents the basic results from the four measures of green skills used for Sweden. As in the other countries, the broadest definition arises from green occupations based on the direct adaptation of the Vona et al. (2015) definition to the ISCO/SSYK classifications. According to this definition, 3.48% of all employees have a green occupation. If we use the narrower and more precise GONST definition of green occupations, the share of employees drops to 0.78%. Based on their educational background, we identified 0.17% of Swedish employees possess green skills. In terms of the activity-based definitions, the overall share of employment is 0.48%, higher than the education-based definition but lower than any of the occupation-based definitions. The picture looks comparable if we consider the share of firms instead of the share of employees (see Table 16).

Table 15. Share and number of employees with green skills in Sweden in 2014.

		Occupation-based		Education-based	Activity-based
	Employment in 2014	Green	Green GONST	Green	EGSS
Stockholm	1,187,586	2.98%	0.66%	0.15%	0.28%
Uppsala	145,747	3.53%	1.22%	0.31%	0.62%
Södermanland	102,301	2.79%	0.54%	0.20%	0.91%
Östergötland	182,465	4.12%	1.12%	0.21%	2.46%
Jönköping	166,225	3.82%	0.53%	0.12%	0.23%
Kronoberg	106,231	3.67%	0.32%	0.14%	0.08%
Kalmar	99,093	3.29%	0.61%	0.17%	0.24%
Gotland	29,013	4.33%	0.58%	0.19%	0.03%
Blekinge	53,909	3.03%	0.59%	0.16%	0.14%
Skane	523,200	3.50%	0.73%	0.17%	0.50%
Halland	127,009	3.61%	0.85%	0.16%	0.35%
Västra Götaland	808,053	3.97%	0.69%	0.16%	0.55%
Värmland	108,373	3.21%	1.58%	0.19%	0.43%
Örebro	158,383	3.16%	0.63%	0.16%	0.25%
Västmanland	127,239	3.66%	0.61%	0.15%	0.37%

Dalarna	134,186	3.82%	0.71%	0.20%	0.25%
Gävleborg	119,066	4.19%	1.04%	0.13%	0.62%
Västernorrland	112,923	3.68%	1.98%	0.15%	1.34%
Jämtland	66,403	2.04%	0.71%	0.30%	0.13%
Västerbotten	118,378	2.99%	1.15%	0.33%	0.26%
Norrbotten	117,803	4.50%	0.94%	0.17%	0.32%
Total	4,593,586	3.48%	0.78%	0.17%	0.49%

Table 16. Share and number of firms with employees with green skills in Sweden in 2014.

		Occupation-based		Education-based	Activity-based
	Firms in 2014	Green	Green GONST	Green	EGSS
Stockholm	135,664	5.15%	0.43%	0.52%	0.11%
Uppsala	17,363	4.36%	0.52%	0.45%	0.15%
Södermanland	12,920	4.61%	0.52%	0.50%	0.26%
Östergötland	19,879	5.57%	0.68%	0.64%	0.18%
Jönköping	16,852	7.52%	0.59%	0.44%	0.20%
Kronoberg	10,291	5.33%	0.46%	0.44%	0.14%
Kalmar	12,888	4.90%	0.61%	0.54%	0.15%
Gotland	4,514	3.57%	0.22%	0.62%	0.02%
Blekinge	6,889	4.63%	0.49%	0.52%	0.12%
Skane	68,174	4.84%	0.50%	0.49%	0.15%
Halland	17,439	4.98%	0.41%	0.35%	0.07%
Västra Götaland	82,582	5.56%	0.55%	0.49%	0.14%
Värmland	14,304	4.77%	0.55%	0.47%	0.22%
Örebro	12,711	5.62%	0.79%	0.55%	0.19%
Västmanland	11,213	5.70%	0.64%	0.54%	0.22%
Dalarna	14,898	4.83%	0.55%	0.48%	0.15%
Gävleborg	14,013	4.49%	0.54%	0.36%	0.22%
Västernorrland	12,217	4.49%	0.51%	0.41%	0.18%
Jämtland	9,134	3.79%	0.54%	0.71%	0.14%
Västerbotten	12,477	5.03%	0.66%	0.65%	0.20%
Norrbotten	12,367	5.10%	0.81%	0.60%	0.23%

The results, however, also show that there are substantial differences between the regions. In order to analyze these differences in greater detail, we have calculated the LQs based on the results in Table 15. These figures can be found in Table 17. In order to facilitate the interpretation of the results, we have presented each of the four LQs in Table 17 and a map in Figure 14.

Table 17. Regional specialization patterns in Sweden.

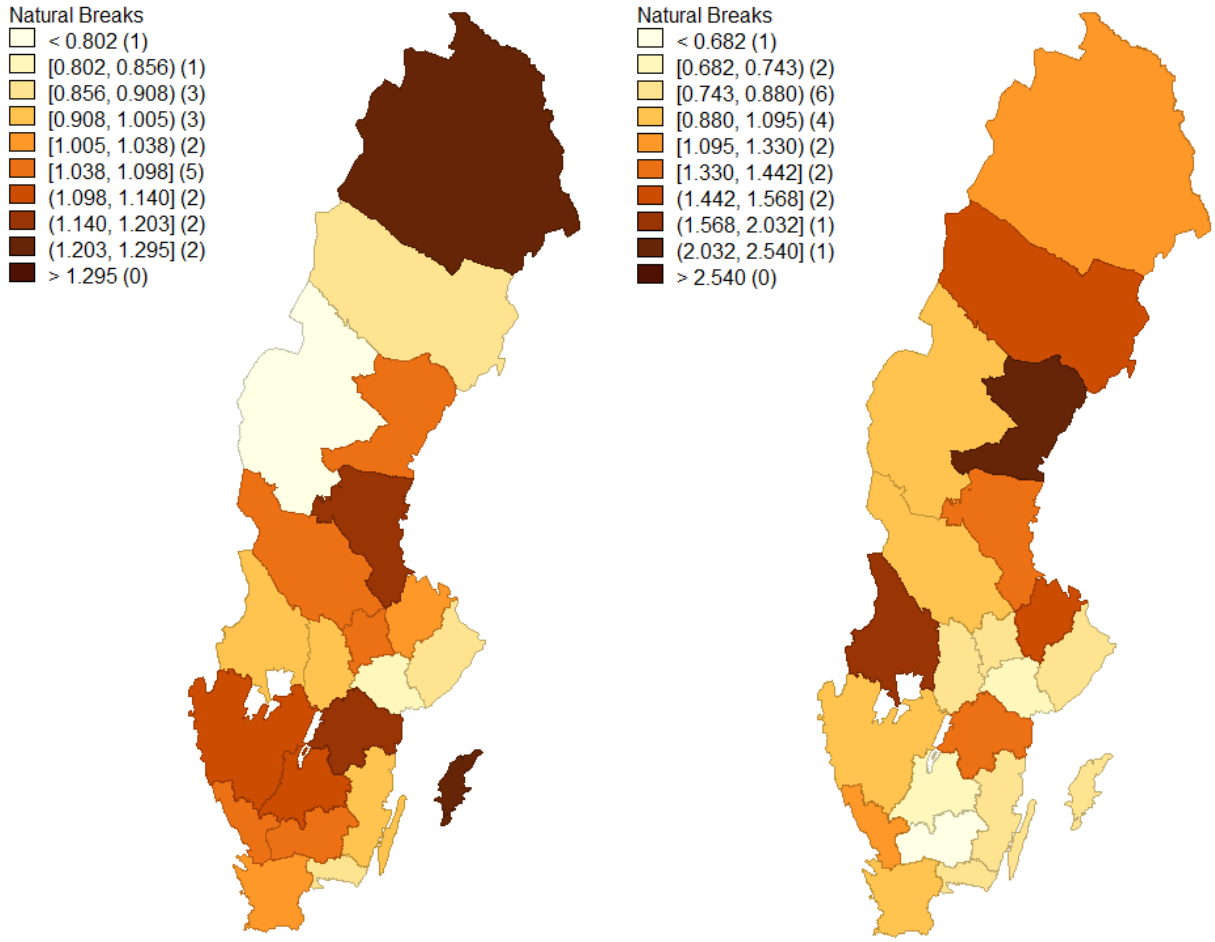
	Employment in 2014	Occupation-based		Education-based	Activity-based
		Green	Green GONST	Green	EGSS
Stockholm	1,187,586	0.86	0.84	0.88	0.57
Uppsala	145,747	1.01	1.57	1.81	1.25
Södermanland	102,301	0.80	0.70	1.14	1.84
Östergötland	182,465	1.18	1.44	1.23	4.99
Jönköping	166,225	1.10	0.68	0.67	0.46
Kronoberg	106,231	1.05	0.41	0.79	0.16
Kalmar	99,093	0.94	0.78	0.98	0.49
Gotland	29,013	1.24	0.74	1.11	0.06
Blekinge	53,909	0.87	0.76	0.92	0.28
Skane	523,200	1.01	0.94	1.01	1.02
Halland	127,009	1.04	1.10	0.93	0.71
Västra Götaland	808,053	1.14	0.88	0.92	1.11
Värmland	108,373	0.92	2.03	1.09	0.88
Örebro	158,383	0.91	0.81	0.93	0.51
Västmanland	127,239	1.05	0.78	0.88	0.74
Dalarna	134,186	1.10	0.91	1.15	0.50
Gävleborg	119,066	1.20	1.33	0.77	1.26
Västernorrland	112,923	1.06	2.54	0.87	2.72
Jämtland	66,403	0.59	0.91	1.71	0.27
Västerbotten	118,378	0.86	1.48	1.88	0.52
Norrbotten	117,803	1.29	1.20	1.00	0.64
Total	4,593,586				

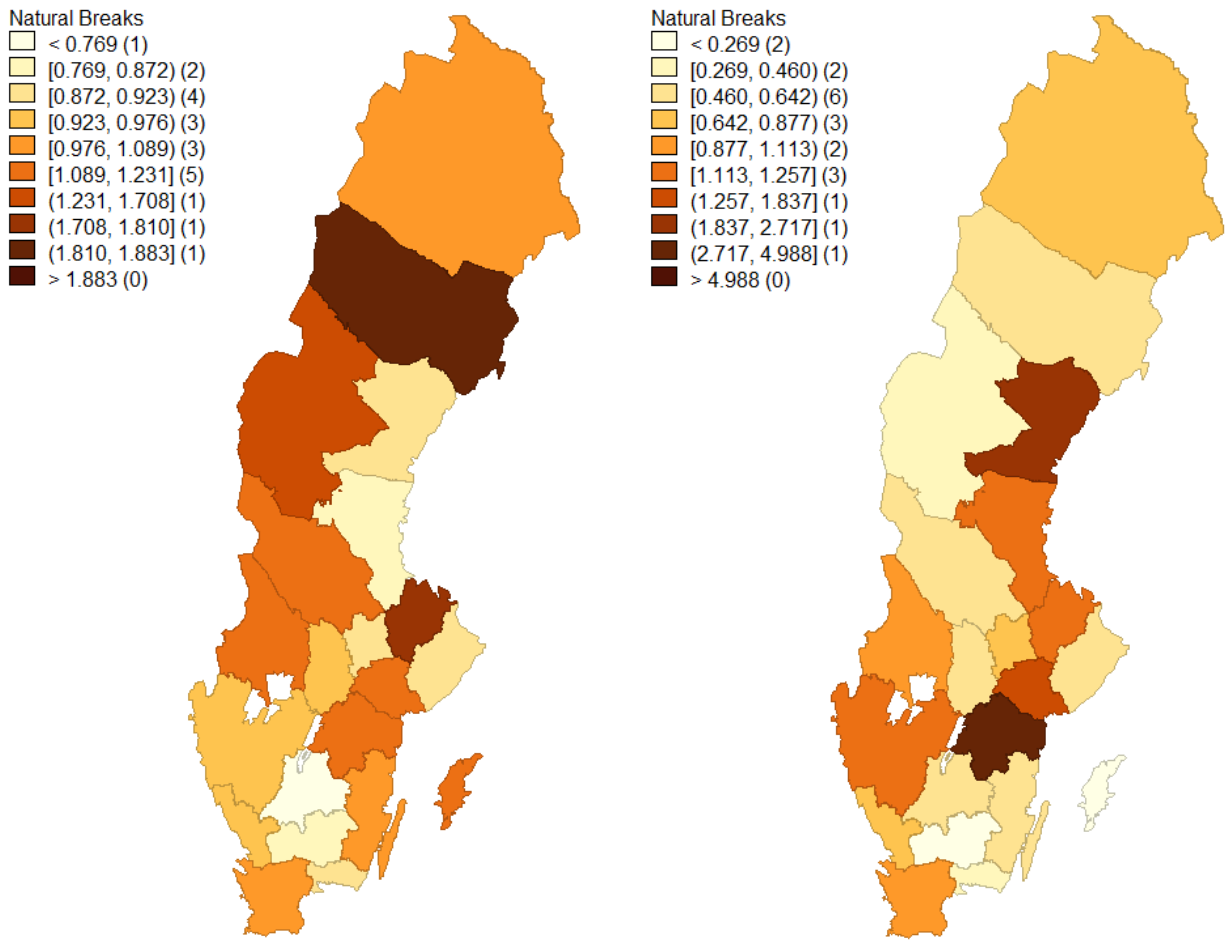
The main take-aways from Figure 13 are, first, that there are tremendous differences between the regions when considering any of the indicators. Second, when considering different indicators for the same region, the LQs differ as well. An important conclusion is that there is little congruence between the indicators and that no single indicator can explain greening or green skills completely. Third, there appears to be quite low regional clustering at the NUTS 3 level because the values of neighboring regions do not seem to have a strong influence on the focal regions.

When looking at the broad occupational definition, Norrbotten has the strongest specialization. Norrbotten however has a relatively low share of employees in EGSS sectors. It is approximately average with respect to the education-based classification. In terms of the narrower *green GONST* occupational definition, the most specialized Swedish region is Västernorrland. Västernorrland has above-average values in terms of the activity-based EGSS definition. But it has only below-average values in the education-based definition and, interestingly, also in the broad occupational definition. In terms of education, Västerbotten is the most specialized region. While however, Västerbotten also has relatively high values in the narrow occupational definition, it is below average in terms of employment in the EGSS sectors and the broad occupational

definition. With respect to the EGSS sectors, Östergötland is by far leading the field. Interestingly, the region is also above average according to the other indicators.

Figure 13. LQs (upper left: green occupations*, upper right:* green occupations GONST*, lower left:* green educations*, lower left:* EGSS*).*





6.2.2 Green innovations

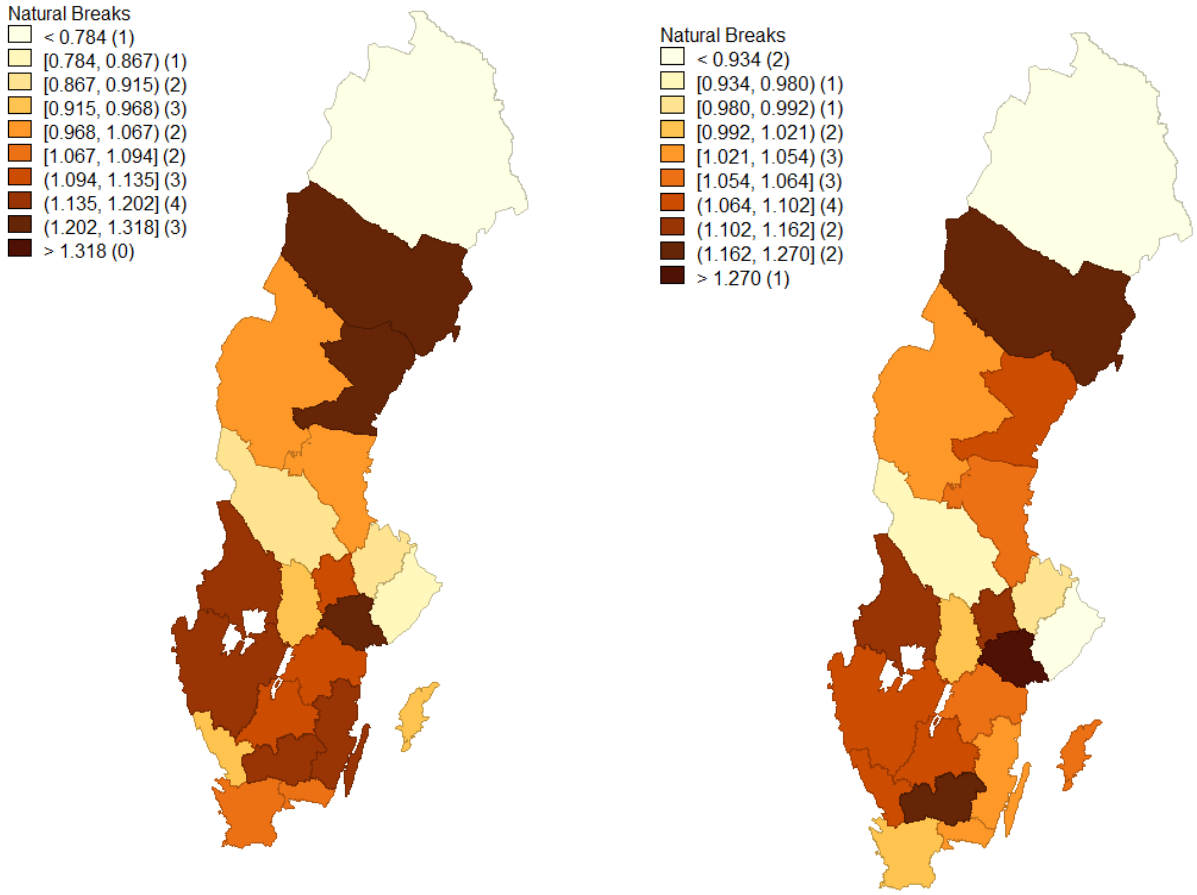
For Sweden, we restricted our analyses to the eco-innovations as defined by the data in the CIS. No information was available on green R&D activities. We considered two indicators of eco-innovations. First, we calculated how many different eco-innovations the firms in a region implemented on average. Second, we calculated the share of firms with at least one eco-innovation.The CIS only covers firms with 10 employees and above, ignoring small firms, which are typically less innovative. This also explains the relatively high share of firms with eco-innovations in the sample. As Table 18 indicates, 31.32% of the firms in the sample introduced eco-innovations in the period from 2012–2014. Furthermore, on average, each firm introduced 1.62 different types of eco-innovations.

Table 18. Green innovators in Sweden in 2014.

		Green innovations			
	Firms in 2014	Average number of innovations types	Share of firms	LQ average number	LQ share
Stockholm	2,131	1.32	26.23%	0.78	0.84
Uppsala	228	1.48	30.70%	0.88	0.98
Södermanland	157	2.22	40.76%	1.32	1.30
Östergötland	306	1.87	33.01%	1.11	1.05
Jönköping	395	1.84	33.42%	1.10	1.07
Kronoberg	186	2.02	39.78%	1.20	1.27
Kalmar	177	1.92	32.20%	1.14	1.03
Gotland	39	1.54	33.33%	0.92	1.06
Blekinge	106	1.84	32.08%	1.09	1.02
Skane	978	1.79	31.08%	1.07	0.99
Halland	235	1.56	33.62%	0.93	1.07
Västra Götaland	1,329	1.91	33.78%	1.14	1.08
Värmland	217	1.94	36.41%	1.15	1.16
Örebro	184	1.58	31.52%	0.94	1.01
Västmanland	174	1.91	35.06%	1.13	1.12
Dalarna	212	1.46	29.25%	0.87	0.93
Gävleborg	196	1.63	33.16%	0.97	1.06
Västernorrland	255	2.07	34.51%	1.23	1.10
Jämtland	147	1.67	31.97%	1.00	1.02
Västerbotten	247	2.13	36.84%	1.26	1.18
Norrbotten	226	1.17	25.66%	0.69	0.82
Total	8,125	1.68	31.32%		

When looking at the maps visualizing the LQs, we can see a relatively high congruence between the two different indicators. We therefore focused on the share of firms with at least one type of eco-innovation. While Södermannsland and Västerbotten reached comparably high values in many of the in many of the education-, occupation-, and activity-based measures, Kronoberg underperformed with respect to these measures.

Figure 14. LQs (left: average number of implemented environmental innovations, right: share of firms with environmental innovations).



While we see that the regional distribution can occasionally differ considerably between the indicators, an important question relates to whether using green skills as an input leads to higher eco-innovations as an output on the firm level. By linking the skills-based measures to the eco-innovators on the firm level, we can test whether the availability of green skills in a firm leads to eco-innovations. To answer this question, we ran regressions of the eco-innovator variables (see above) on the indicators of green skills. Controlling for the region and sector effects, we focused on whether a firm had at least one employee with the respective skills. The results can be found in Table 19 and Table 20.

Table 19. Summary of regression results for eco-innovation (dependent variable: number of implemented innovations).

	(1)	(2)	(3)	(4)	(5)	(6)
Green occupation	0.6101***				0.5628***	
	(0.0692)				(0.0694)	
Green occupation GONST		1.3567***				1.2164***
		(0.1167)				(0.1224)
Green education			0.9846***		0.8731***	0.6287***
			(0.1295)		(0.1301)	(0.1338)
EGSS				0.3685	0.1793	-0.1856
				(0.2659)	(0.2648)	(0.2672)
Employment	0.0008***	0.0008***	0.0007***	0.0009***	0.0007***	0.0007***
	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)	(0.0001)
Share tertiary employment	0.6509***	0.5176***	0.5962***	0.7538***	0.5223***	0.4414***
	(0.1565)	(0.1569)	(0.1576)	(0.1568)	(0.1573)	(0.1575)
Stockholm	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)	(.)	(.)
Uppsala	-0.1083	-0.1627	-0.1235	-0.1114	-0.1159	-0.1651
	(0.2066)	(0.2059)	(0.2068)	(0.2076)	(0.2060)	(0.2057)
Södermansland	0.5077**	0.4744*	0.5091**	0.5415**	0.4700*	0.4603*
	(0.2467)	(0.2459)	(0.2470)	(0.2479)	(0.2461)	(0.2456)
Östergötland	0.2177	0.2045	0.2167	0.2545	0.1858	0.1855
	(0.1823)	(0.1816)	(0.1825)	(0.1831)	(0.1818)	(0.1815)
Jönköping	0.2004	0.2617	0.2622	0.2534	0.2117	0.2664
	(0.1663)	(0.1656)	(0.1664)	(0.1670)	(0.1659)	(0.1654)
Kronoberg	0.4387*	0.5163**	0.4869**	0.4713**	0.4628**	0.5217**
	(0.2283)	(0.2275)	(0.2286)	(0.2294)	(0.2277)	(0.2273)
Kalmar	0.2167	0.2312	0.2206	0.2681	0.1823	0.2047
	(0.2336)	(0.2327)	(0.2339)	(0.2346)	(0.2330)	(0.2325)
Gotland	0.2893	0.3528	0.3895	0.3567	0.3354	0.3744
	(0.4784)	(0.4767)	(0.4790)	(0.4806)	(0.4772)	(0.4761)
Blekinge	0.1006	0.1269	0.1361	0.1162	0.1150	0.1384
	(0.2954)	(0.2944)	(0.2958)	(0.2968)	(0.2946)	(0.2940)
Skane	0.1742	0.1970*	0.1865	0.1954*	0.1665	0.1911*
	(0.1164)	(0.1159)	(0.1165)	(0.1169)	(0.1161)	(0.1158)
Halland	0.0775	0.0794	0.0735	0.0896	0.0662	0.0702
	(0.2054)	(0.2047)	(0.2057)	(0.2064)	(0.2049)	(0.2044)
Västra Götaland	0.3336***	0.3735***	0.3622***	0.3699***	0.3316***	0.3683***
	(0.1055)	(0.1050)	(0.1055)	(0.1059)	(0.1052)	(0.1049)
Värmland	0.3242	0.3388	0.3533*	0.3504	0.3275	0.3418
	(0.2133)	(0.2125)	(0.2135)	(0.2142)	(0.2127)	(0.2122)
Örebro	-0.0826	-0.1201	-0.0410	-0.0211	-0.0888	-0.1223
	(0.2291)	(0.2284)	(0.2293)	(0.2301)	(0.2285)	(0.2281)
Västmannland	0.2315	0.2271	0.2659	0.2593	0.2332	0.2345
	(0.2346)	(0.2338)	(0.2349)	(0.2357)	(0.2340)	(0.2335)
Dalarna	-0.1470	-0.1566	-0.1255	-0.1232	-0.1405	-0.1545
	(0.2154)	(0.2147)	(0.2157)	(0.2164)	(0.2149)	(0.2144)
Gävleborg	0.1415	0.1284	0.1420	0.1410	0.1415	0.1304
	(0.2235)	(0.2227)	(0.2238)	(0.2245)	(0.2229)	(0.2224)
Västernorrland	0.4704**	0.4697**	0.4611**	0.4714**	0.4673**	0.4634**
	(0.1980)	(0.1973)	(0.1983)	(0.1990)	(0.1975)	(0.1971)
Jämtland	0.2304	0.1844	0.1857	0.1922	0.2289	0.1812
	(0.2542)	(0.2532)	(0.2544)	(0.2554)	(0.2535)	(0.2530)
Västerbotten	0.4901**	0.4868**	0.4729**	0.4859**	0.4811**	0.4784**
	(0.2010)	(0.2002)	(0.2012)	(0.2019)	(0.2004)	(0.2000)
Norrbotten	-0.2451	-0.3079	-0.2720	-0.2753	-0.2431	-0.3024

	(0.2089)	(0.2082)	(0.2092)	(0.2099)	(0.2084)	(0.2079)
High-tech manufacturing	0.5469**	0.7092***	0.7099***	0.7040***	0.5645***	0.7125***
	(0.2189)	(0.2175)	(0.2185)	(0.2192)	(0.2184)	(0.2172)
Medium high-tech manufacturing	1.3933***	1.4807***	1.5454***	1.5562***	1.3968***	1.4817***
	(0.1293)	(0.1277)	(0.1281)	(0.1286)	(0.1289)	(0.1275)
Low-tech manufacturing	0.1779	0.2446**	0.3354***	0.3453***	0.1826	0.2487**
	(0.1198)	(0.1182)	(0.1184)	(0.1188)	(0.1195)	(0.1181)
Construction	0.1055	-0.0315	0.1156	0.1594	-0.0062	-0.0416
	(0.1128)	(0.1138)	(0.1131)	(0.1205)	(0.1206)	(0.1205)
High-tech, knowledge-intensive services	-0.6771***	-0.5632***	-0.6082***	-0.6901***	-0.6054***	-0.5240***
	(0.1236)	(0.1236)	(0.1242)	(0.1241)	(0.1237)	(0.1237)
Knowledge-intensive market services	-0.6203***	-0.6962***	-0.6742***	-0.6683***	-0.6294***	-0.6971***
	(0.1040)	(0.1035)	(0.1040)	(0.1043)	(0.1037)	(0.1034)
Knowledge-intensive financial services	-0.9911***	-0.7719***	-0.8663***	-0.9226***	-0.9361***	-0.7515***
	(0.1661)	(0.1658)	(0.1663)	(0.1667)	(0.1658)	(0.1657)
Other knowledge-intensive services	-1.0361***	-0.8572***	-0.9210***	-0.9970***	-0.9656***	-0.8232***
	(0.2173)	(0.2168)	(0.2177)	(0.2183)	(0.2170)	(0.2167)
Intercept	0.9479***	1.1963***	1.2032***	1.2115***	0.9587***	1.1925***
	(0.0940)	(0.0887)	(0.0891)	(0.0894)	(0.0937)	(0.0886)
Observations	8,125	8,125	8,125	8,125	8,125	8,125
R^2	0.084	0.090	0.082	0.075	0.089	0.093

Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 20. Summary of regression results for eco-innovation (dependent variable: eco-innovator dummy).

	(1)	(2)	(3)	(4)	(5)	(6)
Green occupation	0.3140***				0.3061***	
	(0.0320)				(0.0321)	
Green occupation GONST		0.3891***				0.3657***
		(0.0517)				(0.0539)
Green education			0.2277***		0.1821***	0.1318**
			(0.0580)		(0.0584)	(0.0600)
EGSS				0.0959	0.0386	-0.0660
				(0.1178)	(0.1187)	(0.1203)
Employment	0.0003***	0.0003***	0.0003***	0.0004***	0.0003***	0.0003***
	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)	(0.0000)
Share of tertiary employment	0.3138***	0.2943***	0.3284***	0.3666***	0.2850***	0.2763***
	(0.0720)	(0.0724)	(0.0723)	(0.0716)	(0.0727)	(0.0729)
Stockholm	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
	(.)	(.)	(.)	(.)	(.)	(.)
Uppsala	0.0113	-0.0020	0.0096	0.0093	0.0120	-0.0014
	(0.0944)	(0.0943)	(0.0941)	(0.0940)	(0.0945)	(0.0943)
Södermansland	0.2518**	0.2554**	0.2658**	0.2703**	0.2451**	0.2545**
	(0.1093)	(0.1088)	(0.1087)	(0.1086)	(0.1095)	(0.1089)
Östergötland	0.0663	0.0734	0.0773	0.0862	0.0590	0.0690
	(0.0827)	(0.0826)	(0.0825)	(0.0824)	(0.0828)	(0.0827)
Jönköping	0.0782	0.1115	0.1099	0.1082	0.0802	0.1123
	(0.0749)	(0.0746)	(0.0745)	(0.0745)	(0.0750)	(0.0747)
Kronoberg	0.2704***	0.3006***	0.2899***	0.2860***	0.2756***	0.3017***

	(0.1012)	(0.1006)	(0.1007)	(0.1007)	(0.1012)	(0.1007)
Kalmar	0.0138	0.0327	0.0330	0.0431	0.0070	0.0273
	(0.1069)	(0.1066)	(0.1063)	(0.1062)	(0.1070)	(0.1066)
Gotland	0.2536	0.2855	0.2939	0.2874	0.2623	0.2891
	(0.2114)	(0.2105)	(0.2100)	(0.2099)	(0.2115)	(0.2105)
Blekinge	0.0232	0.0343	0.0351	0.0324	0.0241	0.0356
	(0.1341)	(0.1343)	(0.1341)	(0.1339)	(0.1343)	(0.1344)
Skane	0.0212	0.0349	0.0317	0.0332	0.0197	0.0341
	(0.0534)	(0.0533)	(0.0532)	(0.0531)	(0.0534)	(0.0533)
Halland	0.1524	0.1589*	0.1571*	0.1601*	0.1501	0.1570*
	(0.0930)	(0.0926)	(0.0925)	(0.0924)	(0.0930)	(0.0926)
Västra Götaland	0.1186**	0.1390***	0.1355***	0.1364***	0.1184**	0.1382***
	(0.0480)	(0.0479)	(0.0478)	(0.0478)	(0.0480)	(0.0479)
Värmland	0.1838*	0.1952**	0.1979**	0.1963**	0.1847*	0.1959**
	(0.0945)	(0.0943)	(0.0942)	(0.0942)	(0.0945)	(0.0943)
Örebro	0.0153	0.0159	0.0399	0.0432	0.0147	0.0151
	(0.1037)	(0.1037)	(0.1035)	(0.1034)	(0.1038)	(0.1038)
Västmannland	0.1164	0.1221	0.1331	0.1302	0.1176	0.1246
	(0.1059)	(0.1057)	(0.1055)	(0.1054)	(0.1060)	(0.1058)
Dalarna	-0.0228	-0.0172	-0.0079	-0.0072	-0.0216	-0.0173
	(0.0986)	(0.0983)	(0.0980)	(0.0980)	(0.0986)	(0.0984)
Gävleborg	0.1459	0.1444	0.1480	0.1470	0.1463	0.1453
	(0.1010)	(0.1006)	(0.1005)	(0.1005)	(0.1009)	(0.1006)
Västernorrland	0.1377	0.1375	0.1355	0.1361	0.1382	0.1370
	(0.0886)	(0.0885)	(0.0883)	(0.0882)	(0.0886)	(0.0885)
Jämtland	0.1341	0.1125	0.1139	0.1163	0.1333	0.1110
	(0.1146)	(0.1141)	(0.1140)	(0.1140)	(0.1146)	(0.1142)
Västerbotten	0.1879**	0.1879**	0.1835**	0.1860**	0.1863**	0.1863**
	(0.0901)	(0.0901)	(0.0897)	(0.0898)	(0.0901)	(0.0900)
Norrbotten	-0.0314	-0.0595	-0.0450	-0.0453	-0.0322	-0.0581
	(0.0971)	(0.0974)	(0.0968)	(0.0967)	(0.0973)	(0.0974)
High-tech manufacturing	0.4499***	0.5279***	0.5257***	0.5260***	0.4519***	0.5277***
	(0.0946)	(0.0941)	(0.0941)	(0.0941)	(0.0946)	(0.0942)
Medium high-tech manufacturing	0.5365***	0.5963***	0.6117***	0.6131***	0.5375***	0.5966***
	(0.0561)	(0.0557)	(0.0555)	(0.0555)	(0.0562)	(0.0557)
Low-tech manufacturing	0.1291**	0.1832***	0.2098***	0.2122***	0.1294**	0.1835***
	(0.0527)	(0.0521)	(0.0519)	(0.0518)	(0.0528)	(0.0521)
Construction	-0.0393	-0.0607	-0.0105	-0.0008	-0.0647	-0.0601
	(0.0508)	(0.0516)	(0.0509)	(0.0540)	(0.0546)	(0.0548)
High-tech, knowledge-intensive services	-0.3059***	-0.2716***	-0.2904***	-0.3106***	-0.2897***	-0.2622***
	(0.0596)	(0.0596)	(0.0596)	(0.0593)	(0.0598)	(0.0597)
Knowledge-intensive market services	-0.2921***	-0.3293***	-0.3214***	-0.3190***	-0.2949***	-0.3301***
	(0.0493)	(0.0493)	(0.0492)	(0.0491)	(0.0493)	(0.0493)
Knowledge-intensive financial services	-0.3557***	-0.2739***	-0.3078***	-0.3205***	-0.3445***	-0.2690***
	(0.0788)	(0.0786)	(0.0786)	(0.0784)	(0.0789)	(0.0787)
Other knowledge-intensive services	-0.3697***	-0.3040***	-0.3286***	-0.3458***	-0.3551***	-0.2964***

	(0.1033)	(0.1029)	(0.1028)	(0.1027)	(0.1033)	(0.1029)
Intercept	-0.8541***	-0.7161***	-0.7132***	-0.7136***	-0.8506***	-0.7157***
	(0.0437)	(0.0410)	(0.0409)	(0.0409)	(0.0437)	(0.0410)
Observations	8,125	8,125	8,125	8,125	8,125	8,125
*R*2						

Standard errors in parentheses.
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Overall, the results are in agreement irrespective of whether we focus on the probability that a firm introduced eco-innovations (Table 20) or the number of different types of eco-innovations it introduced (Table 19). In all models, we see that both the education- and occupation-based skill measures had a positive and significant effect on eco-innovations. The fact that a firm belonged to an EGSS sector did not have a significant effect. These results were robust irrespective of whether we used the broad or the narrow occupational definition. The results also held when all of the skill-based indicators were included simultaneously. Beyond this major finding that the occupation- and education-based indicators contributed to the introduction of eco-innovations, we again see that there are significant regional differences. Also, the results clearly depended on economic sectors. We see that eco-innovations were more likely in all manufacturing sectors (peaking in medium high-tech sectors) and less likely in services.

7 Country report: Finland

7.1 Introduction

This section describes the differences and similarities in the greening of the Finnish regions. In a similar vein as the other country-specific descriptions and analyses, we used four indicators and added a fifth one. They are as follows: (a) EGSS firms, (b) green occupations, (c) green educations, (d) eco-innovation, and (e) membership in Cleantech Finland (CTF).

7.2 Methodology

7.2.1 Approaches to identifying green skills in Finland

The NACE-based EGSS definition was used (see Section 3) to describe the activity-based greening of the Finnish regions. The Finnish TOL classification is based on NACE, and thus the EGSS classification can be used without losing information. The Finnish TOL classification is fully compatible with NACE.

The analysis of green educations and occupations draws on the Finnish matched employer-employee database (FLEED). The FLEED database is fully compatible with the ISCO-88. The Finnish classification of education is based on UNESCO's International Standard Classification of Education 2011 (ISCED, 2011). In the identification of green educations, we followed the approach outlined in Section 3. The identification of green occupations was based on two definitions. The first definition (*green*) was constructed using 19 occupations and the second (*green GONST*) using six occupations (see appendix).

NUTS were applied to identify regions. In Finland, NUTS 1 refers to the division into Mainland Finland and Åland, and NUTS 2 refers to the five major regions of Länsi-Suomi (western Finland), Helsinki-Uusimaa, Etelä-Suomi (southern Finland), Pohjois- ja Itä-Suomi (northern and eastern Finland), and Åland. In this report, the NUTS 3 level was used. There are 19 NUTS 3 regions. Åland, an autonomous Finnish region, is a special case as it is simultaneously a NUTS 1, NUTS 2, and NUTS 3 region (see the appendix). Åland was excluded from the analyses, as it is a special case that is not always fully comparable with other regions due to its small size.

7.2.2 Identification of eco-innovators in Finland

In the identification of environmentally innovative firms, we included firms that have introduced innovations with environmental benefits for users, the firm itself, or both. The identification was based on the Finnish version of the CIS 2014 survey, which included the voluntary module on innovations with benefits for the environment. In the Finnish survey, firms were asked whether they had introduced innovations with one or more environmental benefits in the period from 2012–2014. The benefits can be for the firm itself or produced during the use of the product or service by the end-user.

Additionally, we analyzed the member firms of CTF to provide additional insights into the regional distribution of firms aiming to build their business on sustainable innovations and related exports. The CTF analysis adds to our understanding of the main Finnish industries that are going green.

7.3 Results

Table 21 shows the share and number of employees with green skills in Finland according to the four different definitions.

Green occupation is the largest classification with 94,249 employees, which represents 4.3% of the total number of employees in Finland. A more streamlined definition of green occupations (*green GONST*) sums to 5,410 employees, which amounts to 0.25% of the total number of employees. Differences between the shares of green occupations in the Finnish regions are fairly minor. In absolute terms, the majority of people working in green occupations are located in the core regions of Finland: Uusimaa, Tampere Region, southwest Finland, and Northern Ostrobothnia. In relative terms, Tampere Region, South Karelia, Satakunta, and Tavastia Proper have slightly more people working in green occupations than the other regions.

The education-based definition found 52,785 Finnish employees with green skills, or 2.41% of all employees. Again, in absolute terms, the strongest economic concentrations of the economy—Uusimaa, Tampere Region, Northern Ostrobothnia, and southwest Finland—have more people with a green education than the other regions. In relative terms, Tampere Region has the highest number of people with a green education, followed by Ostrobothnia.

In 2014, there were 1,101 EGSS firms in Finland employing 8,369 persons, which is 0.28% of all employees. Table 22 shows the relative shares of the employment in EGSS firms in the Finnish regions. In absolute terms, EGSS firms employ the most in the Uusimaa and Tampere regions, which is not surprising as these are the two largest regions in Finland. When viewing the relative share of EGSS firms, the fairly small regions of Satakunta, Tavastia Proper, and Kymenlaakso have the highest share of EGSS firms.

Finnish EGSS firms are fairly small in size (see the appendix). In most fields, they employ less than 20 people. EGSS firms are typically small, local service providers. The only exceptions are firms specializing in the "manufacturing of rubber tires and tubes; rethreading and rebuilding of rubber tires" classification in Tampere Region and the "treatment and disposal of hazardous waste" classification in Tavastia Proper. The former is explained by Nokian Tyres Plc, a major international tire company headquartered in Nokia. It employs 4,600 people in several countries altogether. The latter is explained by Fortum Waste Solutions Ltd, which is located in Riihimäki. It serves all the Nordic countries and specializes in the treatment and disposal of hazardous waste.

Table 21. Share and number of employees with green skills in Finland in 2014.

		Share with green skills				
		Occupation-based		Education-based		Activity-based
REGION	**Employment in 2014**	**Green (%)**	**Green GONST (%)**	**Green (%)**	**Green Finland (%)**	**EGSS (%)**
Finland	2,192,654	4.30	0.25	2.41	NA	0.28
Uusimaa (FI1B1)	714,814	4.33	0.23	2.92	NA	0.19
Varsinais-Suomi (Southwest Finland) (FI1C1)	188,533	4.33	0.18	1.52	NA	0.29
Satakunta (FI196)	85,179	4.69	0.31	1.69	NA	0.47
Kanta-Häme (Tavastia proper) (FI1C2)	70,539	4.63	0.28	1.69	NA	0.46
Pirkanmaa (Tampere region) (FI197)	198,396	4.89	0.20	3.34	NA	0.26
Päijät-Häme (FI1C3)	75,252	4.34	0.24	1.89	NA	0.33
Kymenlaakso (FI1C4)	65,279	4.37	0.25	2.34	NA	0.43
Etelä-Karjala (South Karelia) (FI1C5)	49,416	4.74	0.18	2.49	NA	0.29
Etelä-Savo (Southern Savonia) (FI1D1)	54,737	3.45	0.33	1.89	NA	0.25

Pohjois-Savo (Northern Savonia) (FI1D2)	93,545	4.12	0.31	2.34	NA	0.26
Pohjois-Karjala (North Karelia) (FIiD3)	58,814	3.98	0.40	1.32	NA	0.31
Keski-Suomi (Central Finland) (FI193)	101,678	4.33	0.28	2.20	NA	0.27
Etelä-Pohjanmaa (South Ostrobothnia) (FI194)	74,988	3.65	0.18	1.45	NA	0.27
Pohjanmaa (Ostrobothnia) (FI195)	76,469	4.19	0.22	3.11	NA	0.30
Keski-Pohjanmaa (Central Ostrobothnia) (FI1D5)	27,092	3.85	0.30	1.57	NA	0.39
Pohjois-Pohjanmaa (Northern Ostrobothnia) (FI1D6)	150,704	4.22	0.26	2.58	NA	0.30
Kainuu (FI1D4)	27,488	3.19	0.35	1.52	NA	0.31
Lappi (Lapland) (FI1D79)	664,20	3.98	0.40	1.47	NA	0.33

Table 22 reports the relative share of Finnish enterprises employing at least one green individual—i.e., someone with a green occupation or a green education. As Table 22 indicates, there are larger shares of green educations in Uusimaa, Kainuu, and Lappland, while green occupations raised Tampere Region, Northern Ostrobothnia, and Uusimaa to the top three. The narrow measure of green occupations (*green GONST*) showed the highest shares in Central Ostrobothnia, Ostrobothnia, and North Karelia.

Table 22. Share and number of firms with employees with green skills in Finland in 2014.

		Share with green skills			
		Occupation-based		Education-based	
Region	**Firms in 2014**	**Green (%)**	**Green GONST (%)**	**Green (%)**	**Green Finland (%)**
Finland	236,542	8.64	0.25	1.98	NA
Uusimaa (FI1B1)	67,661	9.22	0.19	2.43	NA
Varsinais-Suomi (Southwest Finland) (FI1C1)	22,620	8.75	0.23	1.95	NA
Satakunta (FI196)	10,055	8.82	0.25	1.49	NA
Kanta-Häme (Tavastia Proper) (FI1C2)	7,891	8.36	0.27	1.53	NA
Pirkanmaa (Tampere region) (FI197)	21,169	9.59	0.22	1.95	NA
Päijät-Häme (FI1C3)	8,781	9.30	0.22	1.73	NA
Kymenlaakso (FI1C4)	6,646	9.03	0.20	1.35	NA
Etelä-Karjala (South Karelia) (FI1C5)	5,187	8.33	0.25	1.25	NA
Etelä-Savo (Southern Savonia) (FI1D1)	7,497	6.82	0.28	1.32	NA
Pohjois-Savo (Northern Savonia) (FI1D2)	10,464	7.44	0.33	1.47	NA
Pohjois-Karjala (North Karelia) (FIiD3)	6,775	7.81	0.34	1.76	NA
Keski-Suomi (Central Finland) (FI193)	11,627	8.13	0.29	2.04	NA
Etelä-Pohjanmaa (South Ostrobothnia) (FI194)	10,643	7.46	0.23	1.48	NA
Pohjanmaa (Ostrobothnia) (FI195)	8,277	8.02	0.40	2.13	NA
Keski-Pohjanmaa (Central Ostrobothnia) (FI1D5)	3,381	7.45	0.47	1.27	NA
Pohjois-Pohjanmaa (Northern Ostrobothnia) (FI1D6)	15,463	8.42	0.30	2.28	NA

Kainuu (FI1D4)	3,031	6.80	0.20	2.41	NA
Lappi (Lapland) (FI1D79)	7,578	8.96	0.36	2.35	NA

As Table 23 indicates, green education showed the strongest specialization in Tampere Region, Uusimaa, and Ostrobothnia, while green occupations raised Satakunta and Tavastia Proper to the top three with Tampere Region. The narrow measure of green occupations (*green GONST*) presented North Karelia, Lapland, and Kainuu as the most specialized regions. When using the activity-based indicator to measure green skills, Päijät-Häme appeared among the most specialized regions along with Tampere Region and Tavastia Proper.

The four different definitions of green skills show a distinct geographical pattern in Finland. Tampere Region is the only Finnish region that is in top three according to three measures and below the national figures only when the focus is on the narrow definition of green occupations. Also, Tavastia Proper seems to be fairly specialized. Some of the smaller Finnish regions appear to be specialized according to one or more of the green measures. This may be due to the small overall number of firms and employment in those regions rather than a strong green sector. Garbage also needs to be collected in smaller regions.

Table 23. Regional specialization patterns in Finland.

		Location Quotient 2014				
		Occupation-based		Education-based		Activity-based
Region	**Employment in 2014**	**Green**	**Green GONST**	**Green**	**Green Finland**	**EGSS**
Finland, total	2,192,654	1.00	1.00	1.00	NA	1.00
Uusimaa (FI1B1)	714,814	1.01	0.92	1.22	NA	0.65
Varsinais-Suomi (Southwest Finland) (FI1C1)	188,533	1.01	0.73	0.63	NA	0.75
Satakunta (FI196)	85,179	1.09	1.27	0.70	NA	0.93
Kanta-Häme (Tavastia Proper) (FI1C2)	70,539	1.08	1.14	0.70	NA	2.46
Pirkanmaa (Tampere region) (FI197)	198,396	1.14	0.80	1.39	NA	1.87
Päijät-Häme (FI1C3)	75,252	1.01	0.99	0.78	NA	1.56
Kymenlaakso (FI1C4)	65,279	1.02	1.00	0.97	NA	1.14
Etelä-Karjala (South Karelia) (FI1C5)	49,416	1.10	0.75	1.04	NA	0.53
Etelä-Savo (Southern Savonia) (FI1D1)	54,737	0.80	1.36	0.79	NA	0.40
Pohjois-Savo (Northern Savonia) (FI1D2)	93,545	0.96	1.27	0.97	NA	0.69
Pohjois-Karjala (North Karelia) (FIiD3)	58,814	0.93	1.61	0.55	NA	0.59
Keski-Suomi (Central Finland) (FI193)	101,678	1.01	1.14	0.92	NA	0.88
Etelä-Pohjanmaa (South Ostrobothnia) (FI194)	74,988	0.85	0.75	0.60	NA	0.69
Pohjanmaa (Ostrobothnia) (FI195)	76,469	0.97	0.90	1.29	NA	0.67
Keski-Pohjanmaa (Central Ostrobothnia) (FI1D5)	27,092	0.90	1.20	0.65	NA	1.11
Pohjois-Pohjanmaa (Northern Ostrobothnia) (FI1D6)	150,704	0.98	1.04	1.07	NA	0.65
Kainuu (FI1D4)	27,488	0.74	1.42	0.63	NA	0.71
Lappi (Lapland) (FI1D79)	66,420	0.93	1.60	0.61	NA	0.69

7.3.1 Eco-innovators

In 2014, 2,376 firms participated in the CIS survey, and 1,848 firms answered the voluntary questions related to environmental innovation. Out of those, 917 reported that they produced eco-innovations (see Table 24). The survey indicates that, nationally, the share of environmental innovative firms is 38.6%. The Finnish regions of North Karelia, Päijät-Häme, Tampere Region, and Tavastia Proper have the highest shares of eco-innovative firms (unweighted). As the numbers are very low, we need to be very cautious when drawing any conclusions based on this measure.

Table 24. Green innovators in Finland in 2014 (unweighted).

		Share with innovations and R&D			
		Green innovation		Green R&D	
Region	**CIS Firms in 2014**	**In region (%)**	**LQ**	**In region**	**LQ**
Finland, total	2,376	38.6	1.00	NA	NA
Uusimaa (FI1B1)	795	39.2	1.02	NA	NA
Varsinais-Suomi (Southwest Finland) (FI1C1)	243	39.1	1.01	NA	NA
Satakunta (FI196)	105	36.2	0.94	NA	NA
Kanta-Häme (Tavastia proper) (FI1C2)	83	39.8	1.03	NA	NA
Pirkanmaa (Tampere region) (FI197)	224	41.5	1.08	NA	NA
Päijät-Häme (FI1C3)	93	41.9	1.09	NA	NA
Kymenlaakso (FI1C4)	72	37.5	0.97	NA	NA
Etelä-Karjala (South Karelia) (FI1C5)	48	35.4	0.92	NA	NA
Etelä-Savo (Southern Savonia) (FI1D1)	41	36.6	0.95	NA	NA
Pohjois-Savo (Northern Savonia) (FI1D2)	98	40.8	1.06	NA	NA
Pohjois-Karjala (North Karelia) (FIiD3)	54	42.6	1.10	NA	NA
Keski-Suomi (Central Finland) (FI193)	90	37.8	0.98	NA	NA
Etelä-Pohjanmaa (South Ostrobothnia) (FI194)	73	32.9	0.85	NA	NA
Pohjanmaa (Ostrobothnia) (FI195)	98	41.8	1.08	NA	NA
Keski-Pohjanmaa (Central Ostrobothnia) (FI1D5)	29	34.5	0.89	NA	NA
Pohjois-Pohjanmaa (Northern Ostrobothnia) (FI1D6)	140	34.3	0.89	NA	NA
Kainuu (FI1D4)	20	40.0	1.04	NA	NA
Lappi (Lapland) (FI1D79)	46	19.6	0.51	NA	NA

Table 25 shows the results of regressions for firms' likelihood of introducing an eco-innovation. The explanatory variables are the share of employees with green skills, the share of highly educated employees, firm size, and controls for region and industry. The regressions show that most of the different definitions of green skills are not statistically significantly related to eco-innovation except for one: the share of employees

with green educations. Firm size is also positively related, while the share of highly educated employees are negatively related to eco-innovation.

Table 25. Summary of regression results for eco-innovations in Finland.

Parameter	Estimate Model (1)		Estimate Model (2)		Estimate Model (3)		Estimate Model (4)		Estimate Model (5)	
Intercept	-1.941	**	-1.888	*	-1.877	*	-1.724		-1.665	
Green occupation	0.074								-0.007	
Green occupation GONST			0.557							
Green education					1.113	*			1.118	*
EGSS							-0.155		-0.168	
Share of highly educated employees	-0.026		-0.027		-0.252	*	-0.024		-0.252	**
Log(Size)	1.127	***	1.127	***	1.118	***	1.126	***	1.118	***
Uusimaa	-0.499		-0.499		-0.524		-0.499		-0.524	
Varsinais-Suomi	-0.480		-0.481		-0.486		-0.483		-0.490	
Kanta-Hame	-0.643		-0.647		-0.657		-0.647		-0.662	
Pirkanmaa	-0.359		-0.362		-0.396		-0.363		-0.402	
Paijat-Hame	-0.417		-0.418		-0.423		-0.421		-0.429	
Kymenlaakso	-0.480		-0.484		-0.494		-0.486		-0.500	
Etela-Karjala	-0.645		-0.655		-0.654		-0.651		-0.663	
Etela-Savo	-0.753		-0.762		-0.760		-0.756		-0.765	
Pohjois-Savo	-0.482		-0.484		-0.486		-0.484		-0.486	
Pohjois-Karjala	-0.421		-0.421		-0.428		-0.426		-0.433	
Keski-Suomi	-0.359		-0.359		-0.347		-0.361		-0.351	
Etela-Pohjanmaa	-0.541		-0.544		-0.552		-0.542		-0.556	
Pohjanmaa	-0.701		-0.702		-0.710		-0.703		-0.711	
Keski-Pohjanmaa	-0.407		-0.409		-0.395		-0.410		-0.398	
Pohjois-Pohjanmaa	-0.630		-0.636		-0.633		-0.636		-0.638	
Kainuu	-0.532		-0.535		-0.552		-0.536		-0.556	
Lappi	0.023		0.026		0.026		0.017		0.018	
Ahvenanmaa	-1.384	**	-1.384	**	-1.388	**	-1.382	**	-1.387	**
High-tech manufacturing	0.210		0.198		0.179		0.202		0.179	
Medium high-tech manufacturing	-0.831	***	-0.842	***	-0.836	***	-0.844	***	-0.846	***
Medium low-tech manufacturing	-0.135		-0.146		-0.152		-0.146		-0.160	
Low-tech manufacturing	-0.194		-0.204		-0.207		-0.206		-0.216	
High-tech, knowledge-intensive services	0.076		0.073		0.120		-0.071		0.113	
Knowledge-intensive market services	0.213		0.209		0.259		-0.202		0.251	
Knowledge-intensive financial services	0.348		0.348		0.348		-0.350		0.348	
Other knowledge-intensive services	0.342		0.339		0.395		0.335		0.387	
R^2	0.156		0.156		0.158		0.156		0.158	
Number of observations	2,326		2,326		2,326		2,326		2,326	

7.3.2 Cleantech Finland

CTF is a national project backed by the government of Finland. It is one of the growth programs of Team Finland, and one of the elements in Finland's National Action plan to develop environmental businesses. CTF aims to bring together expertise from Finland's clean technology industry and research to support clean technology companies internationally. The CTF brand is owned by the Confederation of Finnish Industries, and it is run by Business Finland (previously Finpro, which is now part of Business Finland).

The analysis of the Cleantech Finland member firms provides additional pieces of information about growth- and export-oriented Finnish firms building their business on green products and/or services one way or another. For this purpose, all firms included in the Cleantech Finland network were surveyed and listed in accordance with the green growth categories provided by CTF. The firms were cross-checked both by a visit to each firm's webpage and with the registry data from the Business Information System.[12] This improved the data quality and provided additional insights on what kind of firms develop green solutions for their customers.

CTF has 201 member firms and 12 other partners. Interestingly, only eight out of 201 member firms are classified as EGSS firms (three in the rubber tire business, one in sewage, and three in waste collection and treatment). The categories and the number of firms in each theme are presented in Table 25 and Table 26.

Table 26. The CTF categories and the number of member firms in each category.

Category	*Primary (all)*
Energy & resource efficiency	102 (144)
Waste-to-value	35 (35)
Clean web & the internet of things	29 (29)
Air quality	10 (20)
Renewables & smart grid	8 (39)
Clean water	8 (24)
Bioproducts & materials	1 (19)
Smart transport & logistics	1 (15)
No classification	7 (7)

Table 27. CTF member firms by their location (NUTS 3).

Region	*N*	*%*
Uusimaa	90	44.8
Tampere Region	16	8.0
Tavastia Proper	11	5.5
Central Finland	11	5.5
Ostrobothnia	11	5.5
Northern Ostrobothnia	10	5.0
Southern Savonia	10	5.0
Others	31	15

[12] https://www.ytj.fi/en/index.html. The Business Information System is a service jointly maintained by the Finnish Patent and Registration Office and the Finnish Tax Administration.

7.4 Country conclusion

It is clear that the measures used here are not perfect. It may well be that they do not capture the essence of green growth and the economy. The green economy may be growing everywhere, potentially in all sorts of sectors and firms with many kinds of education. Our interviews with firms and public-sector agencies indicate that the green economy, in its current Finnish form and its many practices, is more about new objectives instead of completely new ways of doing things requiring specific green skills, etc. To simplify, we might say a Finnish engineer with an automation education is simply applying their skill to serve new customer needs instead of introducing completely new products and services to the world. Is this a sign of the greening of regions through non-green educations and occupations? We also need to remember that some of the measures used here contain fairly generic occupations and fields of education.

If we took our measures seriously, we would say that, in absolute terms, the green economy is growing in the core regions of Finland. In relative terms, the overall picture is more varied, and some smaller, fairly traditional industrial regions find themselves in the top four in some measures.

8 References

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9 Appendix

9.1 Definition of industries NACE Rev. 2 (3-digit level)

High-technology manufacturing: 21, 26, 30.3

Medium-high-technology manufacturing: 20, 25.4, 27, 28, 29, 30.2, 30.4, 30.9, 32.5

Medium-low-technology manufacturing: 18.2, 19, 22, 23, 24, 25.1, 25.2, 25.3, 25.5, 25.6, 25.7, 25.8, 30.1, 33

Low-technology manufacturing: 10, 11, 12, 13, 14, 15, 16, 17, 18.1, 31, 32.1, 32.2, 32.3, 32.4, 32.9

Primary, utilities and construction: 01, 02, 03, 05, 06, 07, 08, 09, 35, 36, 37, 38, 39, 41, 42, 43

High-tech knowledge-intensive services: 59, 60, 61, 62, 63, 72

Knowledge-intensive market services (excluding financial intermediation and high-tech services):50, 21, 69, 70, 71, 73, 74, 78, 80

Knowledge-intensive financial services: 64, 65, 66

Other knowledge-intensive services: 58, 75, 84, 85, 86, 87, 88, 90, 90, 91, 92, 93

Other services: 45, 46, 47, 49, 52, 53, 55, 56, 68, 77, 79, 81, 82, 94, 95, 96, 97, 98, 99

9.2 EGSS industries (NACE codes Rev. 2, 4-digit level)

2211 Manufacture of rubber tyres and tubes; retreading and rebuilding

3700 Sewerage

3811 Collection of nonhazardous waste

3812 Collection of hazardous waste

3821 Treatment and disposal of nonhazardous waste

3822 Treatment and disposal of hazardous waste

3831 Dismantling of wrecks

3832 Recovery of sorted materials

3900 Remediation activities and other waste management services

9.3 Green educations[13]

0521 Environmental sciences: Environmental sciences are the study of organisms in relation to one another and to the environment. Programmes and qualifications with the following main content are classified here: Ecology; Environmental science. (UNESCO, 2015; p21).

[13] Description comes from UNESCO (2015) ” International Standard Classification of Education: Fields of Education and Training 2013 Detailed field descriptions”

0522 Natural environments and wildlife: Natural environments and wildlife is the study of the relationships between living organisms in natural environments in order to protect nature and wildlife. It includes the study of establishing and maintaining national parks in order to preserve their original natural state. Programmes and qualifications with the following main content are classified here: National parks and wildlife management; Nature conservation; Wildlife. (UNESCO, 2015; p22).

0712 Environmental protection technology: Environmental protection technology is the study of processes in order to minimise discharge and waste and avoid pollution. It includes programmes dealing with control of water, air, soil etc. Programmes and qualifications with the following main content are classified here: Air pollution control; Ecological technology; Energy efficiency; Environmental engineering; Industrial discharge control; Noise pollution control; Recycling; Water pollution control. (UNESCO, 2015; p 26).

0713 Electricity and energy: Electricity and energy is the study of installing, maintaining, repairing and diagnosing faults in electrical wiring and related equipment in domestic, commercial and industrial establishments. Installation and maintenance of overhead and underground electrical power distribution networks is included. Energy is the study of energy generation. Programmes and qualifications with the following main content are classified here: Air-conditioning trades; Climate engineering; Electrical appliances; repairing; Electrical engineering; Electrical fitting; Electrical power generation; Electrical trades; Energy studies; Gas distribution; Heating trades; Nuclear, hydraulic and thermal energy; Power line installation and maintenance; Power production; Refrigeration; Solar power; Wind turbines (UNESCO, 2015; pp26-27).

9.4 Green educations

9.4.1 National definition Denmark (green ISCED DK)

List of Danish DISCED-15 codes related to green educations[14].

3545: Samfundsvidenskab, tværfaglige uddannelser

354510: Teknologisk-samfundsvidenskabelig planlægning

6114: Tek-Sam - miljøplanlægning, cand.techn.soc.

6149: Tek-Sam - miljøplanlægning, overbygning (RUC)

6186: Tek-Sam - miljøplanlægning (komb. HUM), cand.

6187: Tek-Sam - miljøplanlægning (komb. SAM), cand.

6188: Tek-Sam - miljøplanlægning (komb. NAT), cand.

6189: Tek-Sam - miljøplanlægning (komb. HUM-TEK), c

7182: Tek-Sam - miljøplanlægning, bach.

7196: Tek-Sam - miljøplanlægning (komb. HUM), bach.

[14] http://www.dst.dk/extranet/uddannelsesklassifikation/DISCED-15.pdf

7197: Tek-Sam - miljøplanlægning (komb. SAM), bach.

7198: Tek-Sam - miljøplanlægning (komb. NAT), bach.

7199: Tek-Sam - miljøplanlægning (komb. HUM-TEK), b

354520: Miljøplanlægning og risikostyring

5420: Miljø- og naturessourceøkonomi, c.sc.oecon.

6112: Miljø og ressource management, cand.techn.soc

7061: Miljø og ressource management, bach.

8216: Miljørisiko, cand.scient.

8260: Bæredygtig omstilling, master

8865: Teknisk-videnskabelig miljøvurdering, master

8924: Risikostyring inden for miljø og sundhed, mas

8885: Miljø- og energiret, master

3125: By-, energi- og miljøplanlægning, cand.polyt.

4535: Miljø, tværfaglige uddannelser

453510: Miljø, tværfaglige uddannelser

3261: Energi og Miljø diplomuddannelse

5428: Jordbrug, natur og miljø, c.scient.

8234: Naturforvaltn. landskab-biodiversitet-planlæg

8420: Naturressourcer, bach.

8627: Humanøkologi (TD), diplomuddannelse

8827: Miljøstudier, master

8867: Miljøvidenskab, master

5525: Miljø- og miljøbeskyttelsesteknik

552510: Miljø- og miljøbeskyttelsesteknik

3047: Akvatisk videnskab og teknologi, cand.scient.

3185: Installation og automation, prof.bach.

3352: Akademiuddannelse i i Miljøteknologi

4097: Miljøtekniker

5238: Miljøteknolog

5239: Miljøteknologi, cand.scient.tech.

5272: Miljø, civilingeniør

5386: Fiskeriteknik, civilingeniør

5387: Miljøteknologi, cand.polyt.

5419: Miljøvidenskab, c.scient.

5421: Forest ecosystems, nature and society, kand.

5452: Miljøkemi, c.scient.

7921: Miljøteknologi, ing.bach.

7953: Byggeri og anlæg, vand og miljø, ingeniør bac

8039: Miljøkemi, bach.

8043: Vand og miljø (SDC), c.scient.

8079: Miljøkemi, cand.scient.

8357: Vand og miljø, cand.polyt.

8363: Akvatisk videnskab og teknologi, cand.polyt.

553025: Energiteknologi

3052: Bæredygtig energi, cand.scient.tech.

3127: Energiteknik, cand.polyt.

3128: Vindenergi, cand.scient.tech.

3223: Energi management (overbygning), prof.bach.

3807: Akademiuddannelse i energiteknologi

5174: Energiteknolog

5250: Elektrisk energiteknologi, ing.prof.bach.

5347: Bæredygtig energiteknik, ing.prof.bach.

5356: Energi, akademiingeniør

5391: Energi, civilingeniør

7919: Energiteknologi, ing.bach.

7927: Energi, ing.bach.

8304: Europæisk vindenergi, civilingeniør cand.scie

8305: Vindenergi, cand.polyt.

8306: Bæredygtig energi, cand.polyt.

8343: Energi, civilingeniør

8353: Energiteknologi, cand.polyt.

8372: Bæredygtig energiteknik, cand.polyt.

8910: Vindenergi, master

9911: Vindmølleoperatør, vingeproduktion

9914: Vindmølleoperatør, mekanik og montage

9915: Vindmølleoperatør

9.4.2 National definition Sweden (green ISCED SE)

Green educations include in Sweden:

Environmental sciences (biology) 422z

Environmental protection sciences 85

9.4.3 National definition Finland (green ISCED)

GREEN EDUCATION	FIN
Environmental sciences	0521
Environmental protection technology	0712
Electronics and automation	0714
Natural environments and wildlife (no higher education)	X
Electricity and energy	0713

9.5 Green occupations

SOC 2010	SOC 2010 included in Vona et al.	SOC 6 digits	Title	ISCO -08	ISCO title
11-1011.03	Chief Sustainability Officers	11-1011	Chief Executives	1120	Managing directors and chief executives
11-3051.02	Geothermal Production Managers	11-3051	Industrial Production Managers	1321	Manufacturing managers
11-3051.04	Biomass Power Plant Managers	11-3051	Industrial Production Managers	1321	Manufacturing managers
11-9121.02	Water Resource Specialists	11-9121	Natural Sciences Managers	1223	Research and development managers
11-9199.11	Brownfield Redevelopment Specialists and Site Managers	11-9199	Managers, All Other	1322	Mining managers
13-1199.01	Energy Auditors	13-1199	Business Operations Specialists, All Other	3339	Business services agents not elsewhere classified

13-1199.05	Sustainability Specialists	13-1199	Business Operations Specialists, All Other	3339	Business services agents not elsewhere classified
17-2081.00	Environmental Engineers	17-2081	Environmental Engineers	2143	Environmental engineers
17-2081.01	Water/Wastewater Engineers	17-2081	Environmental Engineers	2143	Environmental engineers
17-2199.10	Wind Energy Engineers	17-2199	Engineers, All Other	2149	Engineering professionals not elsewhere classified
17-3025.00	Environmental Engineering Technicians	17-3025	Environmental Engineering Technicians	3119	Physical and engineering science technicians not elsewhere classified
19-1031.01	Soil and Water Conservationists	19-1031	Conservation Scientists	2133	Environmental protection professionals
19-2041.01	Climate Change Analysts	19-2041	Environmental Scientists and Specialists, Including Health	2133	Environmental protection professionals
19-2041.02	Environmental Restoration Planners	19-2041	Environmental Scientists and Specialists, Including Health	2133	Environmental protection professionals
19-3011.01	Environmental Economists	19-3011	Economists	2631	Economists
19-4091.00	Environmental Science and Protection Technicians, Including Health	19-4091	Environmental Science and Protection Technicians, Including Health	3141	Life science technicians (excluding medical)
47-2231.00	Solar Photovoltaic Installers	47-2231	Solar Photovoltaic Installers	7411	Building and related electricians
47-4099.03	Weatherization Installers and Technicians	47-4099	Construction and Related Workers, All Other	7119	Building frame and related trades workers not elsewhere classified
49-9081.00	Wind Turbine Service Technicians	49-9081	Wind Turbine Service Technicians	7233	Agricultural and industrial machinery mechanics and repairers
49-9099.01	Geothermal Technicians	49-9099	Installation, Maintenance, and Repair Workers, All Other	9622	Odd job persons
51-8099.03	Biomass Plant Technicians	51-8099	Plant and System Operators, All Other	3132	Incinerator and water treatment plant operators
51-9199.01	Recycling and Reclamation Workers	51-9199	Production Workers, All Other	9329	Manufacturing labourers not elsewhere classified
53-7081.00	Refuse and Recyclable Material Collectors	53-7081	Refuse and Recyclable Material Collectors	9611	Garbage and recycling collectors
53-7081.00	Refuse and Recyclable Material Collectors	53-7081	Refuse and Recyclable Material Collectors	9612	Refuse sorters

9.6 Green occupations Norway

Table 28Norwegian occupations included in green occupations

	Freq	Relative
LEDER (MILJØ- OG NATURVERNORGANISASJONE	16	0 %
VASSDRAGS- OG ENERGIDIREKTØR	2	0 %
MILJØVERNLEDER	30	0 %
MILJØVERNSJEF	13	0 %
SIVILINGENIØR (ENERGIRÅDGIVNING)	108	1 %
SIVILINGENIØR (INDUSTRIELL MILJØTEKNOLO	53	1 %
SIVILINGENIØR (MILJØFYSIKK)	17	0 %
SIVILINGENIØR (NATUR- OG MILJØTEKNOLOGI	120	2 %
MILJØVERNKONSULENT	50	1 %
MILJØVERNRÅDGIVER	127	2 %
ENERGIINGENIØR	670	9 %
INSPEKTØR (ENERGIVERK)	41	1 %
OVERINSPEKTØR (ENERGIVERK)	4	0 %
ENERGIMONTØR	1992	27 %
MONTØR (ENERGIMONTØR)	793	11 %
FAGARBEIDER (ENERGIMONTØR)	392	5 %

LÆRLING (ENERGIMONTØR)	864	12 %
FORMANN (ENERGIMONTØR)	236	3 %
SPESIALARBEIDER (ENERGIMONTØR)	70	1 %
ENERGIOPERATØR	185	3 %
FORMANN (ENERGIVERK)	83	1 %
LÆRLING (ENERGIVERK)	91	1 %
ARBEIDSLEDER (ENERGIVERK)	279	4 %
ENERGITEKNIKER	232	3 %
SPESIALARBEIDER (ENERGIVERK)	62	1 %
TEAMLEDER (ENERGIVERK)	64	1 %
OPERATØR (METALLGJENVINNING)	13	0 %
PRODUKSJONSMEDARBEIDER (METALLGJENVINNI	53	1 %
PRODUKSJONSOPERATØR (METALLGJENVINNING)	8	0 %
FORMANN (METALLGJENVINNING)	14	0 %
JERNSKJÆRER (METALLGJENVINNING)	3	0 %
RESIRKULERINGSARBEIDER (GJENNVINNINGSAN	84	1 %
MILJØOPERATØR (RENOVASJON)	98	1 %
MILJØSANERINGSARBEIDER	32	0 %
GJENVINNINGSARBEIDER	360	5 %
GJENVINNINGSARBEIDER (LÆRLING)	10	0 %
SUM	**7269**	**100 %**
sum all occupations (Norwegian yrkkoder)	2288307	0,32 %

green_voc: (yrk_kode) inclusion:

8161108, 3112125, 7244101, 8161105, 8161110, 7244106, 7244108, 8161106, 3152112, 7244107, 161107, 9160114, 2413105, 1227145, 2413113, 1227146, 2413123, 7244103, 3152113, 2143124, 149105, 7244109, 8161115, 1210193, 8161113, 8211118, 1227198, 9160118, 9160119, 8211119, 143104, 9160117, 8211115, 8211116, 8211117, 9160113, 2149107, 2149108.

9.7 Green occupations Sweden

Table 29: Concordance tables for green occupations based on Vona et al. (2016) translated to SSYK

SOC 2010	SOC 2010 included in Vona et al.	ISCO -08	ISCO title	Ssyk-2012	Title
11-1011.03	Chief Sustainability Officers	1120	Managing directors and chief executives	1120	Managing directors and chief executives
11-3051.02	Geothermal Production Managers	1321	Manufacturing managers	1371/1372	Manufacturing managers
11-3051.04	Biomass Power Plant Managers	1321	Manufacturing managers	1371/1372	Manufacturing managers
11-9121.02	Water Resource Specialists	1223	Research and development managers	1331/1332	Research and development managers
11-9199.11	Brownfield Redevelopment	1322	Mining managers	1361/1362	Mining and construction managers

	Specialists and Site Managers				
13-1199.01	Energy Auditors	3339	Business services agents not elsewhere classified	3339	Business services agents not elsewhere classified
13-1199.05	Sustainability Specialists	3339	Business services agents not elsewhere classified	3339	Business services agents not elsewhere classified
17-2081.00	Environmental Engineers	2143	Environmental engineers	2181/2182/2183	Environmental engineers
17-2081.01	Water/Wastewater Engineers	2143	Environmental engineers	2181/2182/2183	Environmental engineers
17-2199.10	Wind Energy Engineers	2149	Engineering professionals not elsewhere classified	2149	Engineering professionals not elsewhere classified
17-3025.00	Environmental Engineering Technicians	3119	Physical and engineering science technicians not elsewhere classified	3119	Physical and engineering science technicians not elsewhere classified
19-1031.01	Soil and Water Conservationists	2133	Environmental protection professionals	2181/2182/2183	Environmental engineers
19-2041.01	Climate Change Analysts	2133	Environmental protection professionals	2181/2182/2183	Environmental engineers
19-2041.02	Environmental Restoration Planners	2133	Environmental protection professionals	2181/2182/2183	Environmental engineers
19-3011.01	Environmental Economists	2631	Economists	2415	Economists
19-4091.00	Environmental Science and Protection Technicians, Including Health	3141	Life science technicians (excluding medical)	n.a.	n.a.
47-2231.00	Solar Photovoltaic Installers	7411	Building and related electricians	7411	Building and related electricians
47-4099.03	Weatherization Installers and Technicians	7119	Building frame and related trades workers not elsewhere classified	7119	Building frame and related trades workers not elsewhere classified
49-9081.00	Wind Turbine Service Technicians	7233	Agricultural and industrial machinery mechanics and repairers	7233	Machinery mechanics and repairers
49-9099.01	Geothermal Technicians	9622	Odd job persons	n.a.	n.a.
51-8099.03	Biomass Plant Technicians	3132	Incinerator and water treatment plant operators	8191	Incinerator and water treatment plant operators
51-9199.01	Recycling and Reclamation Workers	9329	Manufacturing labourers not elsewhere classified	9320	Manufacturing labourers not elsewhere classified
53-7081.00	Refuse and Recyclable Material Collectors	9611	Garbage and recycling collectors	9610	Garbage and recycling collectors
53-7081.00	Refuse and Recyclable Material Collectors	9612	Refuse sorters	9610	Garbage and recycling collectors

9.8 Green occupations Finland

GREEN OCCUPATIONS	FIN
Managing directors and chief executives	1120
Manufacturing managers	1321
Research and development managers	1223
Mining managers	1322
Business services agents not elsewhere classified	3339
Environmental engineers	2143
Engineering professionals not elsewhere classified	2149
Physical and engineering science technicians not elsewhere classified	3119
Environmental protection professionals	2133

Economists	2631
Life science technicians (excluding medical)	3141
Building and related electricians	7411
Building frame and related trades workers not elsewhere classified	7119
Agricultural and industrial machinery mechanics and repairers	7233
Odd job persons	9622
Incinerator and water treatment plant operators	3132
Manufacturing laborers not elsewhere classified	9329
Garbage and recycling collectors	9611
Refuse sorters	9612

9.9 Green occupations GONST

	GREEN GONST		GREEN
ISCO -08	ISCO title	ISCO -08	ISCO title
2111	Physicists and Astronomers		**Not included**
2114	Geologists and Geophysicists		**Not included**
2131	Biologists, Botanists, Zoologists and Related Professionals		**Not included**
2132	Farming, Forestry and Fisheries Advisers		**Not included**
2133	Environmental protection professionals	2133	Environmental protection professionals
2142	Civil Engineers		**Not included**
2143	Environmental engineers	2143	Environmental engineers
2164	Town and traffic planners		**Not included**
2263	Radiation protection expert		**Not included**
3131	Power production plant operator		**Not included**
3132	Incinerator and water treatment plant operators	3132	Incinerator and water treatment plant operators
3143	Forestry Technicians		**Not included**
3257	Environmental and Occupational Health Inspectors and Associates		**Not included**
9611	Garbage and recycling collectors	9611	Garbage and recycling collectors
9612	Refuse sorters	9612	Refuse sorters
	Not included	1120	Managing directors and chief executives
	Not included	1223	Research and development managers
	Not included	1321	Manufacturing managers
	Not included	1322	Mining managers
	Not included	2149	Engineering professionals not elsewhere classified
	Not included	2631	Economists
	Not included	3119	Physical and engineering science technicians not elsewhere classified
	Not included	3141	Life science technicians (excluding medical)
	Not included	3339	Business services agents not elsewhere classified
	Not included	7119	Building frame and related trades workers not elsewhere classified
	Not included	7233	Agricultural and industrial machinery mechanics and repairers

	Not included	7411	Building and related electricians
	Not included	9329	Manufacturing labourers not elsewhere classified
	Not included	9622	Odd job persons

Detailed description of the tasks related to the occupations can be found at the ILO webpage[15].

9.10 Green occupations GONST Sweden

	GREEN GONST		SSYK 2012 GREEN GONST
ISCO -08	ISCO title	ISCO -08	ISCO title
2111	Physicists and Astronomers	2111	**Not included**
2114	Geologists and Geophysicists	2114	**Not included**
2131	Biologists, Botanists, Zoologists and Related Professionals	2131	**Not included**
2132	Farming, Forestry and Fisheries Advisers	2132	**Not included**
2133	Environmental protection professionals	2181/2182/2183	Environmental engineers
2142	Civil Engineers	2142	**Not included**
2143	Environmental engineers	2181/2182/2183	Environmental engineers
2164	Town and traffic planners	2164	**Not included**
2263	Radiation protection expert	2182	Radiation protection expert
3131	Power production plant operator	**Not available**	
3132	Incinerator and water treatment plant operators	8191	Incinerator and water treatment plant operators
3143	Forestry Technicians	2135	**Specialists and advisors in forestry**
3257	Environmental and Occupational Health Inspectors and Associates	2182	Environmental and Occupational Health Inspectors and Associates
9611	Garbage and recycling collectors	9610	Garbage and recycling collectors
9612	Refuse sorters	9610	Garbage and recycling collectors
	Not included	1120	Managing directors and chief executives
	Not included	1223	Research and development managers
	Not included	1321	Manufacturing managers
	Not included	1322	Mining managers
	Not included	2149	Engineering professionals not elsewhere classified
	Not included	2631	Economists
	Not included	3119	Physical and engineering science technicians not elsewhere classified
	Not included	3141	Life science technicians (excluding medical)
	Not included	3339	Business services agents not elsewhere classified
	Not included	7119	Building frame and related trades workers not elsewhere classified
	Not included	7233	Agricultural and industrial machinery mechanics and repairers
	Not included	7411	Building and related electricians
	Not included	9329	Manufacturing labourers not elsewhere classified
	Not included	9622	Odd job persons

[15] http://www.ilo.org/public/english/bureau/stat/isco/docs/groupdefn08.pdf

9.11 Green occupations GONST Finland

GREEN GONST (occupations)	FIN
Environmental protection professionals	2133
Environmental engineers	2143
Power production plant operators	X
Incinerator and water treatment plant operators	3132
Garbage and recycling collectors	9611
Refuse sorters	9612

9.12 Environmental innovations in CIS 2014 (eco-innovators CIS 2014)

Innovation is defined in the CIS 2014 as "An innovation with environmental benefits is a new or significantly improved product (good or service), process, organisational method or marketing method that creates environmental benefits compared to alternatives. The environmental benefits can be the primary objective of the innovation or a by-product of other objectives. The environmental benefits of an innovation can occur during the production of a good or service, or during its consumption or use by the end user of a product. The end user can be an individual, another enterprise, the Government, etc."

The specific questions were:

During the three years 2012 to 2014, did your enterprise introduce a product (good or service), process, organisational or marketing innovation with any of the following environmental benefits?? (Y/N)

- Environmental benefits obtained within your enterprise
    - Reduced material or water use per unit of output (Y/N)
    - Reduced energy use or CO2 'footprint' (reduce total CO2 production) (Y/N)
    - Reduced air, water, noise or soil pollution(Y/N)
    - Replaced a share of materials with less polluting or hazardous substitutes (Y/N)
    - Replaced a share of fossil energy with renewable energy sources (Y/N)
    - Recycled waste, water, or materials for own use or sale (Y/N)
- Environmental benefits obtained during the consumption or use of a good or service by the end user
    - Reduced energy use or CO2 'footprint' (Y/N)
    - Reduced air, water, noise or soil pollution (Y/N)
    - Facilitated recycling of product after use (Y/N)
    - Extended product life through longer-lasting, more durable products (Y/N)

Were any of these environmental benefits due to the following types of your enterprise's innovations?

- Product (goods or services) innovations (Y/N)
- Process innovations (Y/N)
- Organisational innovations (Y/N)
- Marketing innovations (Y/N)

During 2012 to 2014, how important were the following factors in driving your enterprise's decisions to introduce innovations with environmental benefits? (Degree of importance: high, medium, low, not relevant)

- Existing environmental regulations/legislation
- Existing environmental taxes, charges or fees
- Environmental regulations or taxes expected in the future
- Government grants, subsidies or other financial incentives for environmental innovations
- Current or expected market demand for environmental innovations
- Improving your enterprise's reputation
- Voluntary actions or initiatives for environmental good practice within your sector
- High cost of energy, water or materials
- Need to meet requirements for public procurement contracts

Does your enterprise have procedures in place to regularly identify and reduce your enterprise's environmental impacts? (For example preparing environmental audits, setting environmental performance goals, ISO 14001 certification, ISO 50001 certification, etc.).

- Some procedures were implemented before 2012 (Y/N)
- Some procedures were implemented or significantly changed between 2012 and 2014 (Y/N)

9.12.1 Environmental innovations in Denmark (eco-innovators CIS 2014)

The questions differed slightly from the Eurostat questions. Especially since the Danish questionnaire asks about changes or innovations, whereas the Eurostat questions refer solely to innovations. The Danish questionnaire also allows the respondent to answer not applicable (N/A).

Has the firm in the period 2012-14 introduced changes or innovations with one or more of the environmental benefits described below? (Y/N)

- Environmental benefits obtained within your enterprise
    - Reduced material or water use per unit of output (Y/N/NA)
    - Reduced energy use or CO2 'footprint' (reduce total CO2 production) (Y/N/NA)
    - Reduced air, water, noise or soil pollution(Y/N/NA)
    - Replaced a share of materials with less polluting or hazardous substitutes (Y/N/NA)
    - Replaced a share of fossil energy with renewable energy sources (Y/N/NA)
    - Recycled waste, water, or materials for own use or sale (Y/N/NA)
- Environmental benefits obtained during the consumption or use of a good or service by the end user
    - Reduced energy use or CO2 'footprint' (Y/N/NA)
    - Reduced air, water, noise or soil pollution (Y/N/NA)
    - Facilitated recycling of product after use (Y/N/NA)
    - Extended product life through longer-lasting, more durable products (Y/N/NA)

Were any of these environmental benefits due to the following types of your enterprise's innovations?

- Product (goods or services) innovations (Y/N/NA)
- Process innovations (Y/N/NA)
- Organisational innovations (Y/N/NA)
- Marketing innovations (Y/N/NA)

During 2012 to 2014, how important were the following factors in driving your enterprise's decisions to introduce changes or innovations with environmental benefits? (Degree of importance: high, medium, low, not relevant)

- Existing environmental regulations/legislation
- Existing environmental taxes, charges or fees
- Environmental regulations or taxes expected in the future
- Government grants, subsidies or other financial incentives for environmental innovations
- Current or expected market demand for environmental innovations
- Improving your enterprise's reputation
- Voluntary actions or initiatives for environmental good practice within your sector
- High cost of energy, water or materials
- Need to meet requirements for public procurement contracts

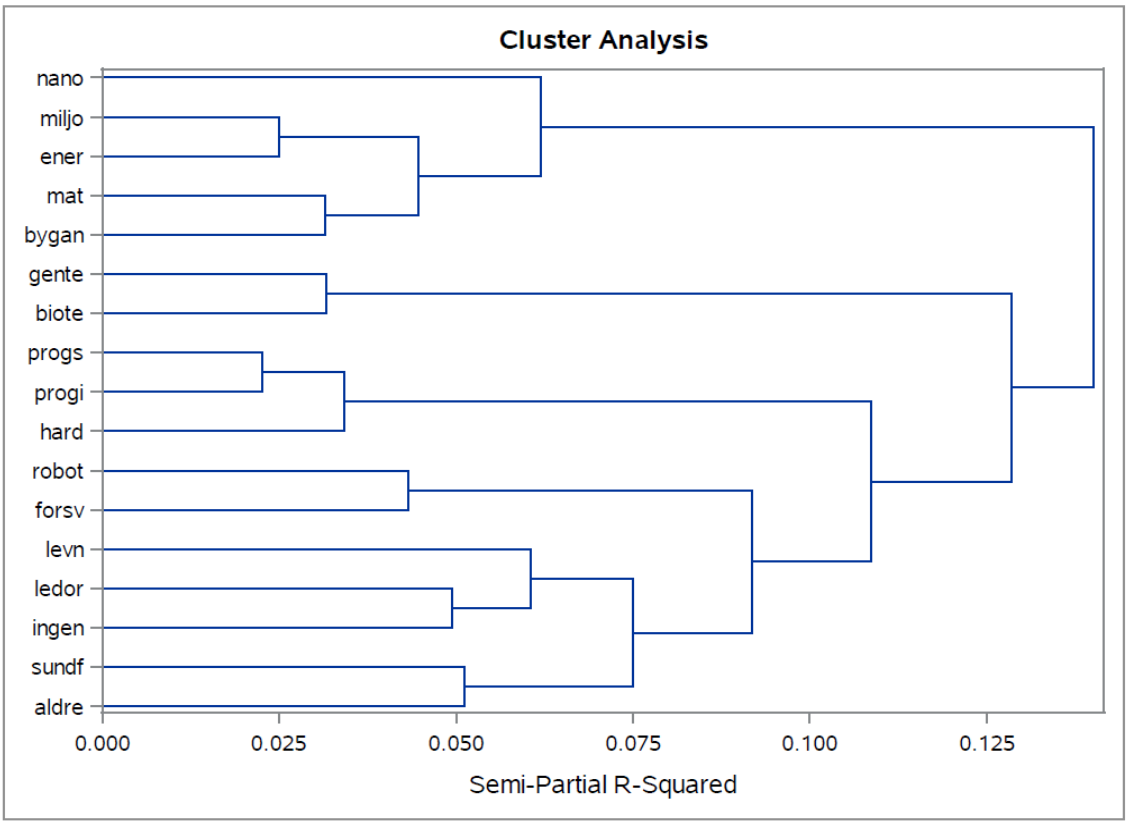
Does your enterprise have procedures in place to regularly identify and reduce your enterprise's environmental impacts? (For example preparing environmental audits, setting environmental performance goals, ISO 14001 certification, ISO 50001 certification, etc.).

- Some procedures were implemented before 2012 (Y/N)
- Some procedures were implemented or significantly changed between 2012 and 2014 (Y/N)

9.13 Environmental R&D spenders in Denmark

Firms' R&D spending in percentages in the following research area categories: materials research, construction, health research, gene technology biotechnology, nanotechnology, food research, energy research, environment research, elderly and assistive technology, defense technology, management research, software integrated in other products, software as independent products, hardware, and other.

Figure 15 Cluster analysis of firms' research areas



9.14 Extra data for Finland

Table 30 The Finnish NUTS3 regions

	Population 1.1.2018	Population density
Finland	5513130	18.1
Uusimaa (FI1B1)	1655624	182.0
Varsinais-Suomi (Southwest Finland) (FI1C1)	477677	44.8
Satakunta (FI196)	220398	28.2
Kanta-Häme (Tavastia proper) (FI1C2)	172720	33.2
Pirkanmaa (Tampere region) (FI197)	512081	40.7
Päijät-Häme (FI1C3)	201228	39.3
Kymenlaakso (FI1C4)	175511	34.1
Etelä-Karjala (South Karelia) (FI1C5)	129865	24.4
Etelä-Savo (Southern Savonia) (FI1D1)	147194	10.3
Pohjois-Savo (Northern Savonia) (FI1D2)	246653	14.7
Pohjois-Karjala (North Karelia) (FIiD3)	162986	9.2
Keski-Suomi (Central Finland) (FI193)	276031	16.5
Etelä-Pohjanmaa (South Ostrobothnia) (FI194)	190910	14.2
Pohjanmaa (Ostrobothnia) (FI195)	180945	23.3
Keski-Pohjanmaa (Central Ostrobothnia) (FI1D5)	68780	13.7
Pohjois-Pohjanmaa (Northern Ostrobothnia) (FI1D6)	411856	11.2
Kainuu (FI1D4)	73959	3.7
Lappi (Lapland) (FI1D79)	179223	1.9
Åland (FI200)	29489	19.0

Table 31 Average size of EGSS firms by sectors and NUTS3 regions in 2014

	Rubber tyres and tubes; retreading and rebuilding of tyres	Sewerage	Collection of non-hazardous waste	Collection of hazardous waste	Treatment and disposal of non-hazardous waste	Treatment and disposal of hazardous waste	Dismantling of wrecks	Recovery of sorted materials	Remediation activities and other waste management services
Finland	48.5	3.1	8.5	5.3	7.9	21.3	3.7	6.8	6.7
Uusimaa	11.7	2.8	13.9	7.0	11.7	1.0	1.3	8.8	3.8
Varsinais-Suomi	0.0	1.5	10.3	.	7.4	.	1.8	7.1	4.4
Satakunta	.	1.3	4.7	.	1.5	.	.	7.1	3.8
Kanta-Häme	.	5.3	8.1	5.7	**18.0**	**58.3**	4.7	5.7	10.3
Pirkanmaa	**141.7**	4.1	5.2	.	7.4	0.0	.	4.6	14.0
Päijät-Häme	.	8.6	10.9	.	6.5	.	.	**18.5**	0.0
Kymenlaakso	0.0	6.0	7.1	.	6.7	.	.	3.5	7.0
Etelä-Karjala	.	.	4.8	.	.	0.0	.	5.4	.
Etelä-Savo	.	.	9.2	0.0	.	0.0	0.0	.	.
Pohjois-Savo	.	1.4	10.0	.	2.4	.	.	6.0	4.3
Pohjois-Karjala	.	.	7.4	.	.	0.0	0.0	2.0	.
Keski-Suomi	.	.	10.1	.	7.9	.	.	7.9	.
Etelä-Pohjanmaa	.	.	6.0	0.0	7.5	.	.	4.0	.
Pohjanmaa	0.0	2.8	.	.	10.6	0.0	0.0	2.3	0.0
Keski-Pohjanmaa	0.0	2.7	6.3	0.0	7.5	0.0	0.0	5.3	0.0
Pohjois-Pohjanmaa	0.0	.	8.8	4.3	4.7	.	.	4.2	.
Kainuu	0.0	0.0	9.4	0.0	0.0	0.0	.	.	.
Lappi	.	6.3	4.5	.	.	0.0	.	4.2	0.0
Ahvenanmaa - Åland	0.0	.	.	.	1.0	0.0	0.0	0.0	0.0

Table 32 Number of EGSS firms by NUTS3 regions in 2014

	Rubber tyres and tubes; retreading and rebuilding of tyres	*Sewerage*	*Collection of non-hazardous waste*	*Collection of hazardous waste*	*Treatment and disposal of non-hazardous waste*	*Treatment and disposal of hazardous waste*	*Dismantling of wrecks*	*Recovery of sorted materials*	*Remediation activities and other waste management services*
Finland	23	255	324	31	173	19	26	198	52
Uusimaa	3	57	50	5	34	3	3	47	8
Varsinais-Suomi	0	41	23	3	13	2	4	14	9
Satakunta	2	14	26	3	11	1	1	18	5
Kanta-Häme	1	8	13	3	7	4	3	15	4
Pirkanmaa	7	23	24	1	10	0	3	17	4
Päijät-Häme	1	12	10	3	8	1	1	10	0
Kymenlaakso	0	13	11	2	11	1	2	6	5
Etelä-Karjala	1	2	12	1	2	0	1	8	1
Etelä-Savo	3	7	9	0	8	0	0	6	1
Pohjois-Savo	1	8	17	1	5	2	1	4	7
Pohjois-Karjala	1	3	16	1	6	0	0	7	2
Keski-Suomi	1	8	19	1	7	2	1	12	2
Etelä-Pohjanmaa	1	15	15	0	13	1	2	3	1
Pohjanmaa	0	8	9	2	14	0	0	11	0
Keski-Pohjanmaa	0	7	8	0	4	0	0	3	0
Pohjois-Pohjanmaa	0	14	29	3	14	2	2	10	2
Kainuu	0	4	8	0	0	0	1	2	1
Lappi	1	9	22	1	3	0	1	5	0
Åland	0	2	3	1	3	0	0	0	0